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**Durham University Business School**

**DBA Thesis**

**2012**

**Keith John Bell**

**Business to Business Enterprise Integration: An exploratory study to develop and test an implementation model for engineer to order organisations.**

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Thesis submitted as part of the requirements for the degree of Doctor of Business Administration of Durham University Business School, 2012.

## Declaration

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Bell, K.J. 'Supply chain integration systems by small engineer to order companies: The challenge of implementation.' *Journal of Manufacturing Technology Management*, Volume 21 No. 1 2010.

Bell, K.J. 'Examining the Drivers and Inhibitors of Business to Business Implementation by Engineer to Order Organisations.' Picmet 2005, Portland 2005.

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## **Abstract**

This research explores the managerial problems associated with adoption of business to business (B2B) enterprise integration in the UK engineer to order (ETO) manufacturing sector. Its aim is to develop a B2B enterprise integration hierarchy to overcome managerial problems and propose a model for implementation. The first part of the research developed an overview of the evolution of the B2B enterprise integration concept, a definition, perceived business benefits and its general status in the UK manufacturing sector. The research is grounded in the extant literature covering supply chain integration, information technology acceptance literature, crisis management and implementation success factors. A qualitative case study approach was selected comprising two phases. The first phase involved key informant interviews at eleven ETO companies in the UK. Three interviews with key informants were carried out at each company. This group triangulation approach mitigated any bias. Four managerial problems were identified: management awareness of the benefits and implementation challenges, risk in terms of return on investment and business continuity during implementation, information security risk associated with loss of competitive advantage and lack of relevant skills within the organisation. From these findings, a B2B de-coupled integration hierarchy was developed and an implementation model proposed. The second phase involved an in case participatory action research study over a one year budget cycle at one of the eleven companies during implementation of a B2B system. This case study tested the use of a B2B de-coupled integration hierarchy approach and refined the proposed implementation model. The outcome of the research recommends a B2B de-coupled integration hierarchy and an iterative implementation model for overcoming the four key inhibitors identified. This is significant for practitioners, particularly in the ETO sector, who are in the process of implementing B2B enterprise integration systems. It confirms that successful implementation can be achieved if senior management teams are fully aware of the potential benefits and the implementation challenges. Additionally, business and information security risks must be dealt with by appropriate de-coupling and the workforce should have the relevant skills to deal with the new systems. From an academic perspective, this research provides two significant contributions. This is the first study to explore the managerial problems associated with adoption of B2B enterprise integration by using a combination of interviewing key informants within an organisational setting and a participatory action case study. Furthermore, it is the first study to propose an iterative implementation model to overcome managerial problems associated with adoption of B2B enterprise integration in the UK ETO sector. It should be noted that this research is limited to key informant interviews at eleven companies and one case study. In order to provide unequivocal validation and generalisability, the research should be expanded to cover other manufacturing sectors.

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## **GLOSSARY OF SELECT TERMS AND ACRONYMS**

C2C	Consumer to Consumer
C2B	Consumer to Business
B2C	Business to Consumer
B2B	Business to Business
ETO	Engineer to Order
ATO	Assemble to Order
MTO	Make to Order
MTS	Make to Stock
MTP	Make to Print
ASP	Application Service Provider
ISP	Internet Service Provider
MRP	Material Resource Planning
ERP	Enterprise Resource Planning
EDI	Electronic Data Information
IT	Information Technology
ICT	Information Communication Technology
IS	Information Systems
SCM	Supply Chain Management
CRM	Customer Relationship Management
XML	Extensible Mark Up Language
AMT	Advanced Manufacturing Technologies
DECS	Defence Electronic Commerce Services
CAD/CAM	Computer Aided Design/Computer Aided Manufacture
AI	Artificial Intelligence
WCM	World Class Manufacturing
BPR	Business Process Re Engineering
GDP	Gross Domestic Product
IPR	Intellectual Property Rights
CEO	Chief Executive Officer
CIO	Chief Information Officer

## CHAPTER 1 – INTRODUCTION

The aim of this research is to investigate the managerial problems associated with adoption of B2B enterprise integration in the UK engineer to order (ETO) manufacturing sector, to develop a B2B integration hierarchy to overcome them and to propose a model for implementation. This thesis is structured to provide the reader with a historical overview of B2B enterprise integration in Chapter 2, followed by the literature review in Chapter 3. Building on these foundations, a description of the methodology used for phase 1 and 2 of the research is provided in Chapter 4. Chapter 5 presents the findings of phase 1 of the research which includes a B2B de-coupled integration hierarchy and a proposed model for implementation. Chapter 6 presents phase 2 of the research which was a Case Study to test the findings of phase 1 research by covering implementation of a B2B de-coupled integration hierarchy and refinement of the proposed implementation model during a full budget operational cycle. Chapter 7 provides a set of recommendations and proposes an iterative implementation model to overcome the managerial problems associated with adoption of B2B enterprise integration for the UK ETO manufacturing sector. The thesis concludes with Chapter 8 summarising the research findings in the context of contribution to theory and practice, limitations and directions for future research.

### 1.1 Previous Research Summary

At the beginning of the twenty-first century, B2B enterprise integration and its application to UK manufacturing businesses attracted interest and development. However, the aftermath of the dot com/E-business disasters caused those businesses which pursued or had plans to pursue B2B enterprise integration to reduce investment in this area of technology. Morgan Stanley confirmed this in May 2001; they reported a decline of around 42% in the level of B2B investment. Justification of the investment continues to be a key issue for manufacturing businesses to adopt this technology. There are a number of other important key issues. A survey conducted by the UK council for electronic business at its millennium roadshow in June 2000 provided an insight into these other issues. There were 56 respondents who completed a simple questionnaire from an estimated population of 300. They indicated their choice of the three main issues against the adoption of B2B enterprise integration in their business. These were lack of executive knowledge, lack of appropriate skill and concerns regarding security. This survey is inconclusive because the visitors to this type of road show are, in general, ICT representatives. As such, the survey is only based on one part of the business process, and although an important part, it is not the most critical. In 2005, the Confederation for British Industry (CBI) updated its 2001 report on the progress of introducing B2B practices into a

range of industry sectors. This report concluded that progress remained slow and there were not only concerns regarding security but also how intellectual property rights (IPR) could be protected. The CBI report only used three companies for its case studies which is not considered to be representative. It is therefore important to establish the managerial problems facing companies embarking on implementation of B2B enterprise integration across a larger sample size.

## 1.2 Overview of B2B Enterprise Integration

According to Hamel (2001), the ubiquity of the Internet provides a platform for businesses to radically rethink the way they operate. He argues that distance and geographical boundaries have become irrelevant. Innovative companies recognise the wider audience this has created for their products and services. As such, he suggests new business concepts that are compatible with the Internet such as the B2B enterprise integration technology that is developing. This enables consumers to obtain goods and services to support their demands from a global market. Hamel (2001) states that computer technology is so far advanced that it is only the limits of human imagination which prevent progress. If businesses consider computer technology to be a key strategic asset and if it is used in a way that suits a business' needs (e.g. B2B enterprise integration technology), responsiveness or agility is not an issue. In this scenario, the global market is available for all businesses. B2B enterprise integration technology is not entirely a new concept; rather it is part of the evolutionary process of e-commerce. As businesses become aware of the power of Internet transactions, they seek to electronify processes such as procurement. Companies have been spending millions of pounds on web enabling old business models. Cox (1997) states that, "Taking a chance on uncertainty – doing things differently and in ways others have not thought of – is clearly the way in which change comes about." This ideology is the approach considered necessary for ETO manufacturing companies to embrace B2B enterprise integration technology. In fact, companies need to consider the entire business process from enquiry to delivery (Buckley, 2001). This means cutting across boundaries such as marketing, accounts, procurement, design, development, testing, production planning, material control, inspection, quality, packing, despatch and transport. Typically, manufacturing companies invested in manufacturing resource planning systems (MRP), or more recently enterprise resource planning systems (ERP). Whilst these systems have the technical capability for total integration, manufacturing companies only use the production-related elements as a means of controlling their business. In ETO manufacturing companies, design, development and testing is typically controlled by bespoke in-house computer programs which may or may not be linked to AutoCAD or another similar computer aided design tool. The concept of B2B

enterprise integration technology is the collection of these independent sub-systems into an interdependent single system which provides an instantaneous response to product variability and demand. Damanpour (2001) describes the potential benefits to businesses if they adopt B2B enterprise integration technology and emphasises the ability for companies to extend their geographical boundaries. This type of seamless integration system also provides ETO manufacturing companies with the basis for leveraging critical supply chain assets to create temporary monopolies or oligopolies, thus improving performance (Cox, 1997). In addition, B2B enterprise integration has provoked entrepreneurial companies to invent innovative logistics management business models, as described by Harrison and Van Hoek (2008). According to Friedman (2006), there are ten events in the globalisation of computer systems that have flattened the world, making B2B enterprise integration globally available in an instant. Therefore, the technology exists and computer systems are sufficiently advanced for a full seamless integration of businesses which leads to the research question ***“What are the managerial problems concerning implementation of B2B enterprise integration practices in UK ETO manufacturing companies and how can these be overcome?”***

### 1.3 Definition of ETO Manufacturing Companies

In order to apply appropriate boundaries to the research, it is considered important by Denzin and Lincoln (2000), to provide a definition of ETO manufacturing companies in the context of this study. Hill (1995) describes manufacturing companies' process strategies as ETO, make to order (MTO), assemble to order (ATO), make to stock (MTS) and make to print (MTP). The effect on lead times in relation to these various process strategies is defined by Hill (1995). He defines ETO manufacturing companies as those who customise generic product types to meet the specific requirements of each customer and only make these to order. Unlike other manufacturing process strategies, ETO lead times therefore include all manufacturing in addition to elements of the engineering design. The elements of the engineering design are value added and usually protected by intellectual property rights or patents. Operating in a global market, which demands responsiveness, is therefore an important consideration. As such, minimising lead times to improve responsiveness is a prerequisite of sustaining market share. Improving the operating performance electronic connectivity of business processes (B2B enterprise integration) would therefore appear to be an essential consideration for these types of companies. This is why ETO companies in the UK are the targets for this exploratory study.

#### 1.4 Academic and Practical Significance of the Research

Current literature and widely publicised national and international initiatives suggest that the implementation of electronic B2B integration systems has a significant impact on organisational performance. These are systems which typically provide the facility for total business integration from supplier to end user. Such systems aim to reduce costs and quality primarily through the accurate and speedy exchange of information through electronic means. Popular examples and applications of such systems include Oracle's, SAP's and Epicor's ERP systems.

A detailed explanation of the impact on organisational performance depends on the nature of the B2B system and the amount of change required for full integration. So for instance, establishing a website and advertising the key products and strengths of a company would require little integration with current business processes. Similarly, the potential operational benefits will be insignificant although sales might increase. At the other end of the spectrum, implementing a B2B system that aims to integrate the processes from suppliers to end users often requires relatively high levels of integration with, and often replacing, older business processes. The practical benefits of adopting B2B enterprise integration across the entire business process provides improved responsiveness, real time data to make informed decisions and reduced operational costs, thereby increasing competitive advantage.

From an academic perspective, the potential business benefits from the adoption of such systems in manufacturing are confirmed by the integration of business processes across a supply chain using advanced information technology systems as proposed by Tan et al. (1998), Frohlich and Westbrook (2001), Childerhouse and Towill (2006) and Flynn et al. (2010). These systems can provide management with real time information (variation change order, contracts, introduction of bespoke products in the manufacturing sequence, real time sales information on bidding and auction) for decision making, lower transaction costs by reducing and automating transaction times, reduction of overheads, provide marketing information and can expand the geographical coverage of the products and services companies offer, e.g. control business from a central location as opposed to several locations as suggested by Damanpour and Damanpour (2001).

The potential benefits outlined in the previous sections have motivated companies to frequently include B2B enterprise integration technology in their business strategy, such as Webster et al. (2006). Yet, despite this potential, relatively few traditional manufacturing organisations have fully and successfully adopted such systems and even fewer have reported

clear benefits. This is commonly the case in ETOs, i.e. manufacturing companies that customise generic product types to meet the specific requirements of each customer and only make these to order as defined previously by Hill (2000). In spite of the importance of this issue for these companies, little empirical work has been carried out to explore the barriers that inhibit this adoption within the context of traditional manufacturing companies in the UK, such as ETOs.

### 1.5 Literature Review Summary

The literature surrounding supply chain integration (SCI) and information technology (IT) systems in the context of B2B enterprise integration is wide ranging. Hamel (2001), Harland (2007) and, Flynn et al. (2010) argue that B2B enterprise integration is inextricably linked to SCI and IT literature concerning technology adoption. Therefore it was decided to ground the research in four areas of extant literature covering supply chain integration, information technology acceptance, crisis management in the context of organisational learning linked to advanced IT systems and ERP implementation success factors. This approach was confirmed by discussions with academia and expert practitioners. Initial focus centred on previous research which identified issues covering supply chain integration (knowledge and awareness of business performance benefits, internal back office concerns), information technology acceptance models (security, employee behaviour), business continuity and B2B integration implementation success factors.

UK ETO companies have attempted to adopt (SCI) as a mode of operation from raw material supplier to end user as proposed by Tan et al. (1998) and Flynn et al. (2010). The facilitating technology for this mode of operation is the B2B seamless integration concept. SCI and B2B enterprise integration are considered inextricably linked because the seamless integration of business systems, from raw material to end user in a global market context, can be achieved effectively by this technology as found by research carried out by Harland et al. (2007). These findings were based on a qualitative methodology on four distinct supply chains over a range of companies targeted at supply chain information integration. This research is helpful in understanding the barriers to information integration and is a useful reference point for the study to be undertaken on ETO companies. However, ETO businesses have experienced problems with implementation of B2B technology when adopting SCI. According to research by Harland et al. (2007), larger businesses are forging ahead with B2B enterprise integration in isolation and are not providing supply chain integration leadership. They claim smaller firms only adopt B2B enterprise integration if dominant customers force them to. The review of the SCI literature identified questions to ask senior managers during the research phase on issues

concerning knowledge and awareness of the business benefits that can be achieved by the adoption of B2B enterprise integration in an SCI context.

Davis et al. (1989), Riemenschneider et al. (2003), Teo and Ranganathan (2004) and Law and Ngai (2007) have explored factors that inhibit the adoption of new technologies in various different contexts. As a result, formal theories and individual factors have been proposed which aim to explain and predict the adoption of new technologies. The most prevailing formal theory is the technology acceptance model (TAM) by Davis et al. (1989), which stems from decision theories and social psychology (Riemenschneider et al., 2003). TAM argues that two particular beliefs – perceived usefulness (the subjective probability that using a specific application system will increase a user's job performance) and perceived ease of use (a user's subjective probability that using a specific application system will increase his or her job performance) – can explain and predict computer usage behaviour (Davis, 1986; Davis et al., 1989). TAM has since been used to explain computer acceptance in various contexts, such as free content websites (Castaneda et al., 2007), and tax filling (Fu et al., 2006). The majority of these studies have focused on the ability of TAM to explain the adoption of computer systems by an individual user or business executives using quantitative techniques to validate their hypotheses (Riemenschneider et al., 2003). A few studies that have used the firm as the unit of study (e.g. Amoako-Gyampah and Salam, 2004) have found that training and project communication can enable the implementation of company-wide IT systems such as ERP.

The literature review goes beyond SCI and information technology acceptance models. It investigates a combination of other management factors that affect the adoption of B2B enterprise integration. Factors such as the management's approach to new technologies (Bontis and Castro, 2000; Tovstiga and Fantner, 2000; Froome, 2001), the environment, a firm's structural characteristics (Bayo-Moriones and Lera-Lopez, 2007), productivity and performance (Brynjolfsson and Hitt, 2000), its approach to risk (Attaran, 2000), employee skill intensity needed (Rahim and Pennings, 1987; Mody and Dahlman, 1992), product complexity within supply chains (Tan et al., 1998; Christopher and Towill, 2000; Childerhouse and Towill, 2006), business continuity and organisational learning (Smith, 1995; Reason, 1998) and the implementation success factors suggested by Damanpour (2001) are the key factors explored in the literature review. Whilst they can affect the adoption of B2B enterprise integration, there is no technological reason why these factors should prevent full adoption of B2B enterprise integration in ETO companies.



## 1.6 Overview of the Methodology Adopted

A qualitative case study methodology was adopted to explore the managerial problems associated with adoption of B2B enterprise integration in ETO companies, develop a B2B integration hierarchy and propose an implementation model to overcome them. The qualitative method would provide a deeper insight into senior management thinking surrounding implementation of the B2B integration concept. This is a preferred approach suggested for research into operations management by Flynn et al. (1990). It was decided to design the research in two phases. Phase 1 would be key informant interviews at a number of companies using questions derived from the literature review and methodology in chapter 3 and 4 respectively. The findings would be used to develop a B2B integration hierarchy for UK ETO companies and a proposed implementation model. Phase 2 would comprise a case study at one company to validate the B2B integration hierarchy and refine the proposed implementation model. In case study research the sample of the cases to be studied needs to be such that the phenomenon examined is observable (Eisenhardt, 1989). Therefore, the chosen cases do not necessarily need to represent the population, as is the case in statistical studies. This study focused on ETO companies in the UK. The companies were identified and contacted using a list of business contacts that the researcher had acquired over a number of years. A total of 11 ETO companies were included on a confidential basis for phase 1. Other ETO companies were willing to participate on a confidential basis but it was decided to stop after 11 companies for two reasons. First, the number and nature of the companies represented a large variety of ETOs in terms of size and technical expertise. Second, it became evident during data collection and analysis that enough data had been obtained and no new information was emerging. Therefore, sufficient data had been gathered to meet the research objectives according to the principles of Strauss (1978).

Descriptive information for each company and their products is included in Chapter 4. The table (in Chapter 4) includes the names of the parent companies of the manufacturing companies examined, the industry sector they belong to, the nature of their products and the number of employees of the business unit included in the study and the parent company in the same year.

Data was collected by interviewing key informants from each participating company. Typically, this included interviews with a director, an operations manager and an ICT manager at each company. These interviews were conducted using a series of open-ended questions. The rationale for the selection of the informants is as follows. The director (often the business unit director) would provide a broader view of the needs, benefits, and aspirations of the new

systems and how they would support the business strategy. The IT manager would provide a technical view of the implementation challenges and how the system is designed to work. Finally, the operations manager would provide an insight into how such systems have changed the day-to-day running of operations. In total, 33 key informants were interviewed. This number is considered to be adequate for this type of analysis, as defined by Miles and Huberman (1994). Furthermore, data was collected by acquiring access and observing how B2B integration systems were used.

During the interviews and observations the focus was primarily on the managerial problems and challenges they faced during implementation. The interview was based on a set of 11 open-ended questions refined during a series of pilots (refer to Chapter 4). The responses were tape-recorded, transcribed and coded using the qualitative analysis software 'atlas.ti'.

Phase 2 provided additional rigour and in depth data through a case study carried out by participatory action research at one of the above companies over a full year budget cycle. This case study followed the implementation of a B2B de-coupled integration hierarchy during a full budget operational cycle. The data collected and used covered minutes of meetings, one-to-one discussions, participation in action teams and key performance indicators. This case study followed the principles for participatory action research as defined by Denzin and Lincoln (2000). The study validated the appropriateness of the B2B de-coupled integration hierarchy developed from the Phase 1 research for UK ETO companies and was used to refine the proposed model of implementation.

## 1.7 Summary of Main Findings

Predictably, the companies analysed provided evidence of B2B systems integration within their operations. The level of adoption varied significantly across the organisations interviewed. At the basic level, all the participating companies had developed websites to advertise their services, while some had to adapt their systems to communicate with those of their customers. Five of the companies had implemented complex ERP business systems, such as SAP/ORACLE, three had implemented affordable ERP systems in the mid-cost range, typically KEWILL/EPICOR and the other three had developed in house bespoke systems for their specific requirements. Finally, all companies had used e-auctions to win new business but considered the process to be inappropriate for ETO companies.

The degree of implementation of such systems varied with the size of the company and their position in the supply chain. More specifically, the larger organisations interviewed

incorporated the implementation of B2B systems within their business strategies, whereas the smaller organisations implemented the systems as a response to their customers' requests. Similarly, organisations that were further down the supply chain reported that their customers were more likely to drive implementation. From the interviews, four themes emerged as key managerial problems preventing the complete implementation of fully integrated systems. These have been identified as: senior management awareness, business risk, information security and lack of relevant skills. A B2B de-coupled integration hierarchy was developed from the findings in phase 1 of the research and a proposed model for implementation proposed.

The in case study carried out at one of the companies during phase 2 of the research was used to confirm the four key managerial problems identified, test the B2B de-coupled integration hierarchy for validity and refinement of the proposed implementation model. The case study revealed affordability and business continuity as issues that needed to be considered in adoption of the B2B de-coupled integration hierarchy for ETO companies. As such, the proposed model for implementation was refined to include these issues as recommendations for companies that were considering adopting B2B enterprise integration.

The findings from the research have both theoretical and practical implications. Firstly, it advances our theoretical understanding of the managerial problems associated with adoption of new systems by traditional organisations, such as ETOs, and provides them with a de-coupled approach to consider for B2B integration and a proposed iterative implementation model. Secondly, it provides detailed information about potential difficulties and how these could be overcome using the aforementioned theoretical model for the implementation of such systems to managers of ETO companies as well as other traditional manufacturing organisations that either aim at, or are in the process of establishing, such integrated systems to improve their process and supply chains.

## CHAPTER 2 – OVERVIEW OF B2B ENTERPRISE INTEGRATION

Due to the rapid rise in Internet technology in global business, the researcher considers it essential to include a chapter to provide the reader with a definition and historical overview of B2B enterprise integration, the business benefits that can be realised from the adoption and implementation of such practices, and the perceived status of B2B in manufacturing organisations in the UK which confirms its slow adoption particularly amongst ETO companies.

### 2.1 A Definition and Historical Overview.

The definition of B2B enterprise integration proposed by Buckley (2001) is considered the most appropriate: *“e-business is about business to business transactions using electronic tools as a means to an end for product customisation in a seamless chain from raw material to end user.”* This definition is not specific to manufacturing industries but to all businesses in general where advanced computer technology is used to integrate activities/functions within companies and between companies. In simple terms, B2B involves businesses selling things to each other over the Internet using global supply chains. Businesses have traded electronically for over 30 years via EDI systems and then by bespoke purchasing systems or e-mail. However, since the arrival of the Internet, businesses have a standard universal communications system through which they can trade. Bontis and Castro (2000) considered that the Internet creates a virtual universal market square on which any business can set up its own stall and begin trading.

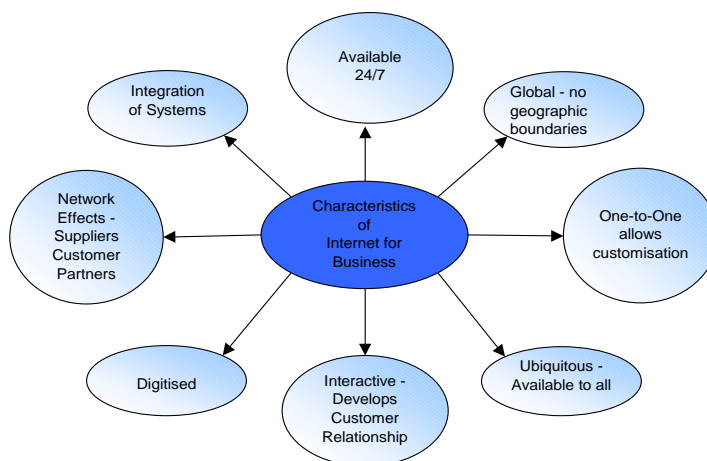


Figure 1. Buckley (2001). Internet business model

According to Porter (2001), the Internet facilitates speedy, real-time transactions with suppliers, partners and customers, wherever they are in the world, 24 hours a day, seven days

a week (24/7). The characteristics of using the Internet as a trading tool are summarised by Figure 1.

According to Heck (2000), the resulting effect on the business world due to the arrival of the Internet has been twofold. Firstly, existing 'bricks and mortar' businesses examine their operating methods to see how using the Internet can improve their efficiency and profitability, that is, they look to 'e-enable their existing businesses'. For some, this goes as far as establishing a separate Internet-based operation/company to run alongside the traditional bricks and mortar company. In the Business-to-Consumer (B2C) world, examples of this type of move are Egg (Prudential) and Smile (Co-operative Bank).

Secondly, a plethora of new Internet-based operators has been established. Essentially, these consist of three types of organisation: "virtual intermediaries" – companies established to operate on the Internet as brokers between business buyers and sellers; infrastructure providers (such as Internet Service Providers (ISPs) and Application Service Providers (ASPs)) and finally, Internet-based businesses established to trade their products and services directly via the web (Hooft, 2001).

According to Dodds (2000), these operators instigated the growth of the so-called B2B e-commerce market. Thus, the impact of the Internet for businesses can be summarised by Figure 2. Since B2B became the recognised term for the Internet economy, different waves of B2B operators have entered the market. The first wave consisted of 'net market makers' who were established to match buyers and sellers in independent market places, for which the market maker would take a commission. Heck (2000) estimated that more than 100,000 of these net market makers had been established by 2001. Hybrids of the pure net market maker sites include catalogue sites and auction sites.

In a response to these new market makers, Wang (2000) and Wen et al. (2000), existing businesses (who were beginning to trade via the net) started to set up their own industry-based marketplaces with their trading partners – known as 'vortals'. More than 1,000 of these industry mega market places were established by 2002. According to Berryman (2000), many of the early arguments for these vortals – improved industry efficiency, lower purchasing costs – have been replaced by improved supply chain management (SCM) and collaborative design activities.

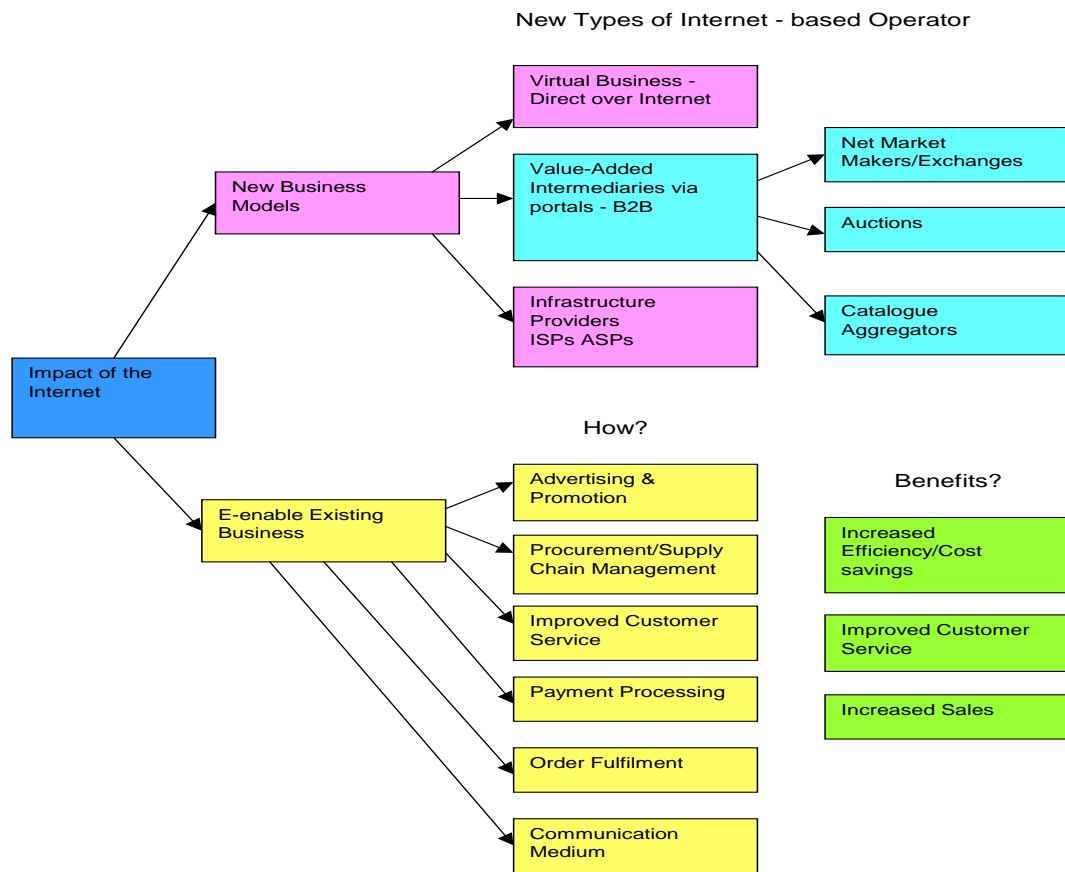


Figure 2. Dodds (2000). Internet business impact

According to Berryman (2000), the next “wave” for the B2B Internet-based intermediaries involved their users “using a mix of the e-commerce intermediaries to improve profitability and competitiveness.” Users became increasingly discerning as to the effects on bottom line profitability from using B2B intermediaries.

Thus, whilst B2B market places and vortals continued to have their place, many of the business portals in existence would collapse as users became increasingly discerning in their usage. Nunny (2000) suggested that those B2B exchanges which do survive will need to change to meet business demands – they must evolve from mere market places for commodities to fully integrated service markets, which will allow companies to purchase customised goods (the birth of B2B enterprise integration technology).

For traditional bricks and mortar companies looking to e-enable their existing business, Figure 3 defines the steps that should be taken to fully embrace the benefits of e-technology.

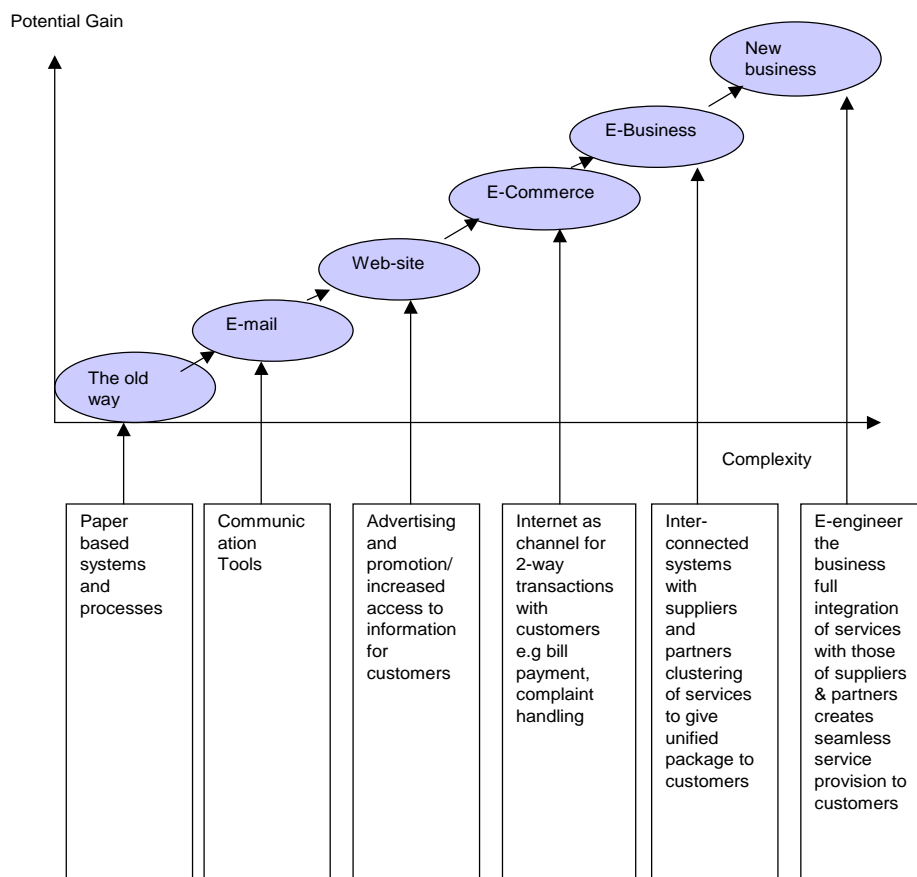


Figure 3. Nunny (2000). Steps required to embrace e-technology

In the period 2000 to 2002, most businesses in the UK were at the 'website' stage of the model (refer to Adams (2000)) where advertising the companies products was the primary objective. Some businesses were beginning to consider the complexity of moving towards the 'e-commerce' stage, which involved websites becoming interactive, as suggested by Loebbecke (2001). Archer (2000) comments that websites should be designed to make/accept payments, allow customers to order/purchase services/products and act as a channel for handling customer complaints and other service issues. This has all been realised and is now taken for granted by businesses.

According to Bagchi (1998) and Baker (2001), larger multi-nationals, particularly within the automotive and pharmaceutical sectors, had begun to operate at the 'e-business' level. These companies used portals to network their own product/services with those of their suppliers/partners. The customer accesses one portal to obtain a full service so that disparate services are now viewed as a unified package. The customer's perception of the separate businesses behind that service became blurred.

The “new business models” suggested by Kotorov (2001) and Jain (2001) remained “visionary” for some time and only affordable by the most sophisticated businesses in the UK. This represented a step change from the previous level in that it involves the “deep integration of business processes” between the host company and all of its suppliers – this is B2B enterprise integration technology. Internal stock controls, procurement systems, servicing and delivery standards become integrated with those of the suppliers. The integrated technology between all partners proposed by Themistocleous (2001) means that the customer obtains a seamless service with all of the businesses behind the portal appearing as one to the customer. Further characteristics of the “new business models”, suggested by Porter (2001), are that non-core activities are outsourced and that businesses need to e-engineer their back office processes, structures, culture and people in order to facilitate the new way of operating. A balanced strategy approach, as proposed by Kaplan (2001), is considered appropriate.

## 2.2 Perceived Business Benefits

Damanpour (2001) considered that the next generation of the Internet was evolving, and it meant businesses doing everything faster, better and cheaper. B2B enterprise integration quickly moved to the forefront of technology priorities. This was confirmed by the UK government’s raft of initiatives in the Journal of the UK Council for Electronic Business (Autumn 2000). The importance of this initiative can be confirmed by using the 2011 ONS survey data (Fig 4) which confirms the increasing value of B2B transactions in the UK.

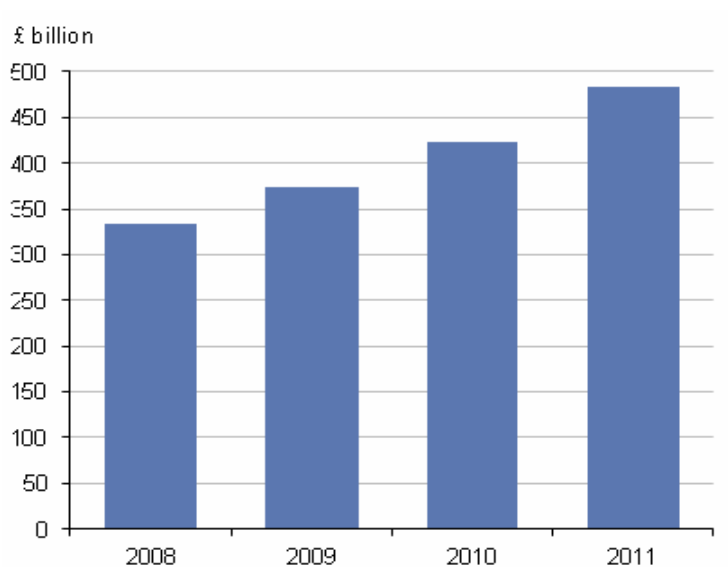


Figure 4. The value of UK B2B transactions (2008 – 2011).

(Source; Office of National Statistics 2011 survey)



The business case for manufacturing to adopt B2B enterprise integration technology gathered momentum during 2002. An article by Owen (2002) in *The Financial Times* stated that multinational corporations are unbundling their empires to concentrate on core competence using new technology as a means of integrating processes. Another article by Muggeridge (2001) quoted B2B enterprise integration technology as a means of injecting entrepreneurial spirit into their management by analysing how best to exploit Internet technologies. Damanpour (2001) described six benefits that can be attributed to B2B, as follows.

#### 2.2.1 Responsive Management Information

This allows management instantaneous access to sales data for reporting and analysis. Rao (2000) states that enterprise integration technology enables efficient production, a lower inventory and more responsive distribution. In addition, knowledge within the organisation is increased by shared data, marketing and sales becoming visible and transparent and financial data being online for improved decision making. These improvements contribute to the effective use of financial resources for Research & Development into new products for the future.

#### 2.2.2 Seamless Integration of Supplies and Vendors

Having the right products available at the right time and price and knowing how to sell them with greatest effect enhances the benefit. B2B enterprise integration technology allows businesses to provide responsive information about product availability, changes to the product, pricing and the businesses' promotional policy. These are essential ingredients for UK ETO manufacturing businesses. However, the critical success factors proposed by Soliman (2000) need to be observed to ensure the overall systems are compatible.

#### 2.2.3 Lower Transaction Costs

The reduction of costs and efficiency factors are considered to be important benefits of B2B enterprise integration technology. In the long run Internet-based transaction systems cost less because they reduce the need for a large organisational system.

#### 2.2.4 Online Marketing Data

B2B enterprise integration transactions can automatically extract information about customers and their buying behaviour. The customer's data is captured along with their transactions, thereby creating a new mechanism for predicting market trends or targeting repeated or related sales. Carter et al. (2000) attempted a 10-year forecast for purchasing and supplying in a global context. Their forecast has been realised with the advances in sophisticated computer software.

#### 2.2.5 Expanded Geographical Coverage

B2B enterprise integration systems can be accessed from any place at any time, thereby eliminating barriers. According to Muggeridge (2001), they allow businesses to sell and deliver products and services across the world. Therefore, it is beneficial for UK ETO manufacturing companies to adopt B2B and extend their reach far beyond traditional boundaries.

The business case validity for companies needs to be thoroughly evaluated before embarking on a strategic initiative to implement B2B enterprise integration technology. Hansen et al. (2000) attempt to provide an evaluation model using the balanced scorecard. They conclude that this is not easy to formulate. Tovstiga and Fantner (2000) summarise that the emerging network economy brought about by the Internet represents a major shift in the competitive environment. In order for companies to survive, they must embrace entirely new patterns of innovation, processes and business models that have little in common with traditional approaches as suggested by Hamel (2001), Freedman (2006) and Harrison and Van Hoek (2008).

### 2.3 Status of B2B Enterprise Integration in Manufacturing

The previous sections outlined the evolution of B2B enterprise integration technology, which can be considered as four main categories of commerce conducted over the Internet: consumer-to-consumer (C2C); consumer-to-business (C2B); business-to-consumer (B2C) and business-to-business (B2B). Examples of the four categories are as follows: trading forums (C2C); Priceline.com (C2B, B2C) would include companies such as Amazon.com. The B2B transaction market is considered to be nascent and potentially quite large. In 2003, the estimated market size in the UK was valued at £150 billion and this expanded dramatically from 2004 to 2011. The estimated value of the B2B transaction market in the UK from the

ONS is £475 billion with manufacturing at £150 billion. However, Adams (2000) and Harland (2007) claim that UK ETO manufacturing businesses have been slow to adopt this technology. Adams' (2000) B2B development map attempts to categorise value and integration into five waves of e-commerce. This is a useful model for positioning businesses. Over the past decade globalisation of computer systems has created a flat platform for all companies to improve business performance by adopting B2B enterprise integration as proposed by Friedman (2006). At one end of the scale, there are businesses with only a basic knowledge and use of the Internet and at the other end there are businesses that operate a seamless integrated B2B system. ETO companies have not taken full advantage of B2B practices because they have only integrated part of their business process. The seamless logistics management B2B model adopted by computer businesses could be considered as a model for ETO manufacturing companies to follow. However, this has not been the case, so what are the managerial problems concerning the adoption of B2B enterprise integration in UK ETO companies and how can they be overcome?

Based on the above, the case for ETO manufacturing companies to adopt B2B enterprise integration is strong in terms of the potential benefits if these are realised. According to Adams (2000), Friedman (2006) and Harrison and Van Hoek (2008) adopting this technology is possible due to a conjunction of the following events.

#### 2.3.1 Business Process Recognition

Advances in business processes, organisational design and supporting ICT now allow individual businesses to identify and functionally isolate core competencies within their organisations. Hamel and Prahalad's (1990, 1994) work on core competencies and competing for the future confirms this viewpoint.

#### 2.3.2 Growth of the Internet

The growth of the Internet and in particular the World Wide Web shifted thinking about the role of ICT in the conduct of business and the ability to integrate dispersed elements of a business process. Porter (2001) outlines the importance for businesses to develop a strategy which takes advantage of the Internet to provide sustained competitive advantage rather than a quick fix which only yields a short-term gain whilst the competition players catch up.

### 2.3.3 Proof of Concept

Proof of role models has demonstrated significant reductions in cost and cycle times for various manufacturing processes and significant new market development when using the concept of agile virtual enterprises. Jain et al. (2001) provide the basis for manufacturers to consider simulated modelling for virtual factories which can be compared with the improvements made by companies who have successfully adopted B2B enterprise integration.

### 2.3.4 Recognition and Acceptance of Novel Business Forms

The limited liability company, the limited liability partnership and the business trust forms of organisation demonstrate that methods of organisations and capitalisation of business enterprise have become sophisticated. Companies constantly seek new ways of organising and combining elements of their business to achieve competitive advantage. Hamel (2001) challenges businesses to radically rethink the way they operate by using computer technology and entirely new business concepts.

### 2.3.5 Increasing Sophistication of Collaboration Tools and Communication Infrastructure

According to Hamel (2001), “technology is no longer a barrier to the creation and co-ordination of totally integrated enterprises.” Large distributed, relational databases will become the norm. Open standards of structure and communication such as XML (extensible mark up language) are being adopted to facilitate this.

### 2.3.6 The Major Catalyst

Businesses are struggling for innovative new approaches to achieve a sustained growth of above average returns, particularly in UK manufacturing. The seamless integrated enterprise models proposed by Jain et al. (2001) and Rao (2000) are considered to provide the potential for improved performance. Logistics and supply chain management (Lambert, 1998; Harrison and Van Hoek, 2008) are considered to be key elements, as summarised by Lambert (1998): *“the successful integration and management of key business processes across members of the supply chain will determine the ultimate success of the single enterprise.”* Logistics management and competing through the supply chain using B2B enterprise integration is creating new business models for all types of products and services on an unprecedented scale, suggests Friedman (2006).

Given the above, the ubiquity of B2B practices and government initiatives it is difficult to comprehend why UK ETO companies are apparently slow to adopt B2B enterprise integration technology. On the basis of the above, ETO manufacturing companies could improve performance if they adopted this technology, increase their competitive advantage and aspire to become global enterprises.

UK ETO manufacturing companies have new operational business models for guidance, a set of events to consider and a catalyst to drive implementation of the B2B enterprise integration concept. Therefore, the proposed research question, ***“What are the managerial problems concerning implementation of B2B enterprise integration practices in UK ETO manufacturing companies and how can these be overcome?”*** requires answering because the business benefits have been clearly identified.

The challenges for a business to adopt B2B enterprise integration could be externally driven by sector forces and customer requirements. The reported slow adoption of this concept in the manufacturing sector could be due to internal organisational pressures as a consequence of inappropriate management and a lack of awareness of the business benefits. The proposed research aims to investigate the managerial problems which are preventing B2B enterprise integration from being fully adopted by ETO manufacturing companies, to develop a B2B integration hierarchy and a proposed model for implementation. The proposed research is specific to B2B enterprise integration technology within ETO manufacturing businesses in the UK. The specific targeting within this industry sector should enable ETO manufacturing businesses to gain valuable knowledge from the research for future B2B implementation strategies in their search for improving performance in the global market. Furthermore, it seeks to provide academic empirical knowledge, recommendations for implementation and implications for future research in this field.

## CHAPTER 3 – LITERATURE REVIEW AND PROPOSED RESEARCH QUESTION

As explained in Chapter 2, B2B enterprise integration in ETO manufacturing companies is concerned with using advanced IT systems as a means of product customisation in a seamless chain from raw material to end user as stated by Buckley (2001). Previous research carried out by Morgan Stanley (2001), Froome (2001), the Confederation of British Industry (2001 & 2005), and Sanders (2007) claims the adoption of B2B enterprise integration amongst manufacturing companies in the UK is inhibited by a lack of awareness among executives regarding the potential business benefits, lack of appropriate employee skills and concerns with information security such as protection of IPR. The purpose of this research is to explore these managerial problems specifically in ETO supply chains and develop a model to overcome them. The aim of this chapter is to discuss and review the four main bodies of extant literature covering supply chain integration, information technology acceptance, crisis management in the context of organisational learning linked to advanced IT systems and ERP implementation success factors.

### 3.1 Supply Chain Integration (SCI)

Manufacturing businesses continually explore new technologies to reduce their cost base and remain competitive as identified by Rosenzweig et al. (2003), Narasimhan and Kim (2002) and Flynn (2010). They argue that adoption of enterprise integration systems to collaborate with suppliers and customers improves business performance across supply chains. They claim this is achieved by eliminating unnecessary interfaces, reducing transaction times and using lean operating systems. As a consequence, manufacturing companies have sought to adopt supply chain integration (SCI) as a mode of operation from raw material supplier to end user as proposed by Tan et al. (1998). The facilitating technology for this mode of operation is B2B enterprise integration systems such as SAP and Oracle. Flynn et al. (2010) provide a contemporary definition of SCI, which is the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organisational processes, in order to achieve effective and efficient flows of products and services, information, money and decisions, to provide maximum value to the customer. Previously, B2B XML technology has been promoted by IT experts to 'connect' business level systems between different enterprises. The vision of B2B XML in an SCI context, according to Darling (2000), is *"to enable a global electronic market place where enterprises of any size and in any geographical location can meet and conduct business with each other through the exchange of XML-based messages."* This was relevant and a significant impact to SCI between customer, manufacturer and supplier. However, technology has moved beyond the

flow of information using B2B XML as found by Flynn et al. (2010). They identify that internal integrated business process management is essential and is a key factor in realising enhanced performance and that it is insufficient to have only XML-based SCI connectivity between enterprises. The internal process of each enterprise should be evaluated and reinvented to provide a mutually beneficial seamless automated system. Peppard and Ward (2005) suggest business executives are dissatisfied with the value realised from investments in IT systems such as B2B enterprise integration. They claim IT has no inherent value itself but requires detailed planning and management through all aspects of the business cycle. A two-stage model is proposed by them which distinguishes between “problem-based” and “innovation-based” implementations. Their underlying message, relevant to any SCI operation, is that unlocking business value from IT investments is a journey not a destination and this journey must be both planned and managed. Earlier work by Jurison (1996), Ward et al. (1996) and later research by Peppard et al. (2007) proposes an approach to realise business benefits from IT investments by new ways of working between IT professionals and business managers. As discussed earlier, Flynn et al. (2010) identify the importance of internal integration of business processes. This is relevant to ETO manufacturing companies because they operate on bespoke internal solutions which provide them with their competitive advantage as suggested by Cox (1997). In any SCI by ETO companies using B2B enterprise integration the bespoke parts of their business practices must be protected to maintain their competitive advantage. This could be an important inhibitor to the adoption of B2B enterprise integration because ETO companies would require protection for bespoke parts of their business as a means of protecting competitive advantage. This will be discussed later in section 3.2.1 (Information Systems Security Issues).

An integrated approach to manufacturing systems modelling for virtual factories is proposed by Jain et al. (2000). The internal organisational integration of functions that Jain et al. (2000) suggests is of interest in understanding the decision making process for investment which is important for executive decision making. Investment decisions on advanced manufacturing technologies (AMT) to provide the platform for SCI have been studied by Burcher and Lee (2000). They conclude that UK manufacturing companies assess AMT proposals carefully, particularly Auto/CAD or CAD/CAM systems. Investment decisions are taken on the inter-organisational benefits (operational cost savings) rather than on how it could enhance SCI by improving information flow to customers and suppliers.

The difficulty in overcoming the interchange of data between enterprises was investigated by Kim (2000). This investigation proposes enabling integrated decision making for electronic commerce by modelling an enterprise’s sharable knowledge. It is generally accepted by

businesses that the Internet is a global medium and driving new business models, which include integration of supply chains. This is captured by Rao (2000): *“A major shift in the communications between business organisations is taking place which is actually re-defining organisations and commercial transactions. The Internet has become a key element in moulding and propelling business into new directions in the traditional market place and emerging market space.”* This approach has been found to be successful for commodity products. However, this approach, although accepted for commodity products, has not been accepted by UK ETO manufacturing companies because products are not standard, they are customised using bespoke designs. For example, each order for a supply item could be different. Customers become exacting and demand a wider variety of products with minimal lead times. Work has been undertaken on SCI, particularly in the area of standardised products such as the automotive sector. Older theoretical frameworks, such as Forrester (1958) and Lamming (1993), have been developed further by Frohlich and Westbrook (2001), Childerhouse and Towill (2006) and Flynn et al. (2009). These new frameworks are being applied by the larger commodity manufacturing organisations as referenced by Harland et al. (2007). However, for ETO manufacturing companies these frameworks, for synchronised supply chains, are not appropriate because they do not provide for customised delivery of bespoke products. Consideration also needs to be given to the inter-organisational issues raised by Flynn et al. (2010) and overcoming the barriers to information sharing found by Harland et al. (2007). According to research by Harland et al. (2007), larger businesses are forging ahead with B2B enterprise integration in isolation and are not providing supply chain integration leadership. They claim smaller firms only adopt B2B enterprise integration if dominant customers force them to. A well integrated supply chain involves coordinating the flow of materials and information between suppliers, manufacturers and customers, such that production and distribution are synchronised to actual end user demand using world class operations as proposed by Bagchi (1998), Graham (2000), Tucker (2000) and Flynn et al. (2009). The ideal target state is where all the participating companies think and act as one in a seamless manner as proposed by Childerhouse and Towill (2006). This is particularly relevant to high volume manufacturing companies who use B2B enterprise integration as the enabler for seamless integration of business processes between and within companies. Previous research by the CBI in 2005 identified that ETO manufacturing companies are reluctant to adopt these practices. However it is important to review these to identify any technical or theoretical reasons why ETO manufacturing companies would not adopt them. The following are identified as important practices to consider for implementation of SCI using B2B enterprise integration, which are appropriately defined by Frohlick and Westbrook (2001), Germain et al. (2008) and Harrison and Van Hoek (2008).



*Lead Time Compression:* This technique is at the heart of both lean and agile approaches. It both enables greater responsiveness and reduces cost. In addition to the cost savings from reduced stock, the agile supply chain will benefit from the increased responsiveness, which again helps it to reduce stock and obsolescence costs.

*Waste Elimination:* This is at the core of lean methodology – to manufacture the product with the minimum amount of raw material required. In an agile company, there may be excess labour, equipment or materials required allowing the necessary responsiveness. Conversely, lean companies may have difficulty responding to dramatic changes in demand.

*Process Flexibility:* The ability to rapidly changeover a production process is a key aspect of lean thinking, as changeover time is waste, but additionally in an agile supply chain it affects the responsiveness and levels of lost sales, and hence the practice is even more important. In an agile process this may include production cells which are arranged to manufacture a wide range of products (mass customisation) as opposed to the classic single product cells often seen in lean companies. It may also include the introduction of flexible working practices, such as annualised hours.

*Level Scheduling:* In order to facilitate efficient cells or production lines, lean thinking would guide a company to smooth its demand requirements through forward planning. This is possible where lead times are longer and demand variation is relatively small. Conversely, agile companies are set up to exploit the opposite situation.

*Process Re-Design;* A key issue for potentially agile supply chains, which is considered to be essential for ETO companies, is the position of the decoupling point. This occurs at the separation between the front end of the organisation or supply chain, which is directly responding to customer orders and the back end, which is making to forecast. Its position varies from one company/supply chain to another and is strongly influenced by the difference between the production lead time for the product and the delivery lead time demanded by the customer. This decoupling allows the use of both lean and agile methodologies and is termed leagile by Childerhouse and Towill (2000).

As market demand becomes more volatile, lean supply chains are under pressure to become agile. Whilst lean and agile are often seen as opposites, much of the lean philosophy and practices are the foundations of effective agile production. ETO companies are considered to require a combination of both methodologies. The mix is dependent on the markets served, demand variances and product types. The return on investment and productivity

improvements are also significant considerations regarding SCI and the adoption of B2B enterprise integration. In consideration of the above it is clear from the SCI literature that frameworks for seamless integration of supply chains using B2B technology exist and have been adopted by commodity manufacturers. However, the literature is not explicit in how the frameworks can be applied to ETO companies. Previous limited research, such as the CBI 2005 survey, has attempted to explain some of the reasons for the slow adoption of B2B integration amongst a small number of ETO companies but this lacks rigour in its content. To address this gap in the literature part of the proposed research programme will investigate the strategic and organisational reasons within the ETO manufacturing fraternity for the apparent slow adoption of B2B enterprise integration practices.

### 3.1.1 Internal Company Supply Chain Integration (SCI)

Implementing B2B enterprise integration within SCI is essential for ETO companies to maintain their competitive advantage and hence their survival, according to Norton (2010). According to Soliman et al. (2001) and Flynn et al. (2009), this integration is not just about customer/supplier relationships but it is within the four walls of a company. For optimal performance, businesses require information from a variety of sources within and outside the enterprise – from the shop floor, suppliers, customers and partners – and companies need that information to reach all the relevant individuals quickly. It is therefore important to explore the different integration scenarios, of which there are four according to Childerhouse and Towill (2006).

*Functional Integration:* This deals with integration between business level applications and factory floor systems. Businesses need to get plant and machines integrated, with knowledge flowing around them, between them and then to business level systems in ‘real time’ rather than days or weeks. This enables management to react quickly to problems on the shop floor and subsequently make informed business decisions based on what is happening now, not what happened in manufacturing three days ago. The new and powerful ERP systems such as SAP, ORACLE and for the smaller companies Kewill and Epicor solutions, provide the enabler for integration. Framework designs are also emerging, as suggested by Senzen (2008), which make the system integration process faster and less painful for businesses. Rao (2000) researched the business needs and technologies for implementing ERP systems. Themistocleous et al. (2001) conducted research into the problems that businesses must overcome in the application of integration. They concluded that most companies do not implement a full ERP suite due to existing in-house bespoke systems. This, in part, is considered to be a problem relating to management rather than the technology.

Themistocleous et al. (2001) stated, *“Many companies did not abandon their legacy systems but they tend to integrate the functionality from disparate applications.”* This is considered by Handy (2002) to be more to do with the culture manifested in a company rather than the technological barriers. This is particularly relevant to ETO companies because they protect their IPR and bespoke systems which are built up over generations within their legacy systems. The challenge is to link all these disparate/legacy systems and their associated processes together in order to access corporate data, which may reside in a number of different databases across the enterprise. This is particularly relevant to ETO companies who are a global enterprise with a number of geographic manufacturing locations.

*Enterprise Application Integration:* Companies need data to move in and out of legacy (home grown or not) systems or, for example, between customer relationship management (CRM) and back end enterprise systems. Furthermore, the shift towards B2B e-commerce puts emphasis on accessing data which resides in a number of separate systems across different enterprises in a supply chain, such as suppliers, customers and channel partners. Nah et al. (2001) discuss the critical factors for successful implementation of enterprise systems and summarise the importance in the following quote. *“Businesses today face a stark reality: anticipate, respond, and react to the growing demands of the market place, or perish”*. The speed at which businesses need to anticipate, respond and react can only be achieved by integrating business systems using the latest technology. For ETO manufacturing businesses, integration is about being effective and there is existing efficient collaboration between departments within a company and between businesses in a supply chain.

*Synchronous Supply and Information Enrichment:* The retail industry has been successful in developing synchronised supply chains by moving towards “richer” information sharing, which has been termed Efficient Consumer Response (ECR). Here customers openly share the visibility of demand information in real time, which has a significant effect on reducing both lead times and artificial demand amplification. Boyer and Hult (2005) confirm this for the on-line grocery industry. However, for ETO manufacturing companies, the four areas of uncertainty are pronounced and, as such, information enrichment is crucial to successful B2B enterprise integration. Croom et al. (2000) discuss the need for inter-plant planning and logistical integration. This can be achieved by integrating or connecting the ERP systems of suppliers, manufacturers and customers. Vendors of ERP systems are developing additional packages that use the Internet to link the ERP systems of suppliers (see for example Roberts and Mackay, 1998), manufacturers and customers and hence to create what became known as virtual supply chains or extended enterprises. Fisher (1997) argues that technology alone is not the perfect solution it was expected to be. He stresses the importance of companies

matching their supply chains to their market, i.e. they either become appropriately efficient or responsive. For example, a survey by Little (1999) identified the automotive supply chain as being advanced in synchronisation, but weak in matching supply to actual demand. For ETO manufacture companies, the demand is customising each order; the problems lie in synchronising the supply chain throughout the entire business process, both internal and external as suggested by Childerhouse and Towill (2000).

*Customised Delivery:* This section describes the Childerhouse and Towill (2000) model for ETO manufacture companies based on customised delivery, built upon the synchronous and information enrichment concepts, where products are made on demand to customer specification. The past success of the DELL model of direct sales of a customised product, combined with an integrated and information enriched supply chain, generated interest from the automotive, aerospace and engineering industries. G. R. Wagner, president and CEO of General Motors, stated, "DELL is the Holy Grail." Managing upstream and downstream beyond the factory walls and the effects of strategic integration have been explored by Swink et al. (2007). This work compliments the progression in SCI models, particularly relevant to Figure 5, adapted from Childerhouse and Towill (1999), which illustrates the progression in SCI models.

This diagram illustrates the application of information enrichment, distributing sales data into a common material planning system that communicates schedules via Internet links to each level of the supply chain. The common material planning system acts as a single point of control, synchronising the supply chain and removing multiple decision points. Synchronisation with customer demand using information management is at the heart of the demand chain management concept as described by Korhonen et al. (1998).

This represents SCM with an emphasis on matching customer requirements in line with the core strategy of an ETO company. As Tan (2001) identifies, *"In a truly 'integrated' supply chain, the final consumers pull the inventory through the value chain instead of the manufacturer pushing the items to the end users."* However, this could lead to operation slack if demand falters with a consequential loss of efficiency.

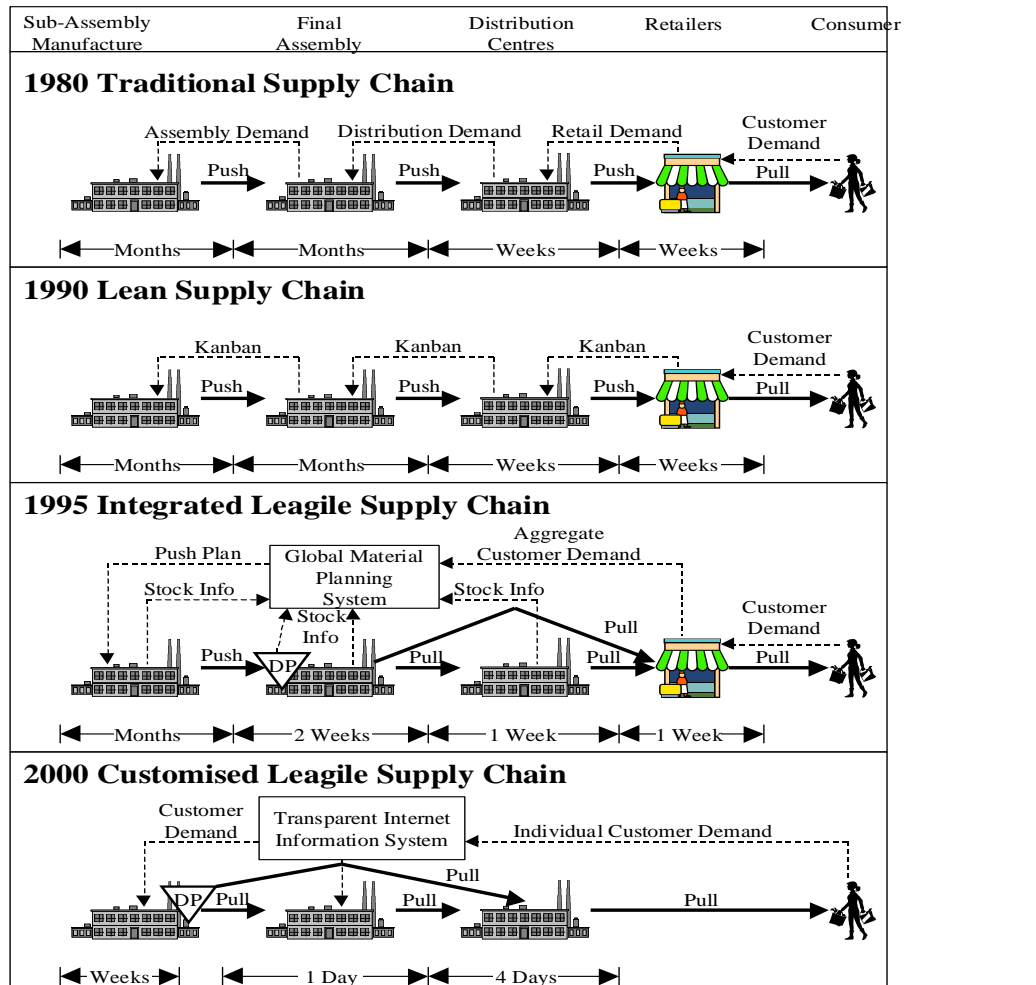


Figure 5. Childerhouse and Towill (2000). Progression in SCI models

The effects of operational slack were considered by Hendricks et al. (2009). They found that firms with more slack in their supply chains experience less negative stock market reaction. The 'customised leagile' model uses direct sales and short process lead times to allow products to be made directly for individual customers, rather than through forecasts for general markets (Christopher and Towill, 2000).

Christopher and Towill (2000) propose that most commodity manufacturing companies are not demand driven, but forecast driven, with little information on actual customer requirements. On the contrary, ETO companies only start working after an order has been received similar to DELL and the customised leagile SCI model. This is because ETO company strategy is generally based on using just in time (JIT) principles, low inventory and only manufacturing components when they are required in assembly. ETO companies generally do not manufacture to stock. The key to SCI success is seen to be the ability to use, co-ordinate and leverage the strengths in the network to create a greater responsiveness to market needs.

Towill (1997) makes the point that synchronisation requires the existence of a strong, key player in the chain, 'a predator', who has the vision, desire and authority to create an integrated chain. The work of Harrison and Van Hoek (2008) provides a collective and contemporary view on the theory of competing through the supply chain by using integrated logistics management models.

The customised leagile model has been found to be effective for the PC supply chain, e.g. DELL. There is no technical or theoretical reason why these practices could not be adopted by ETO companies if the issues around lead time could be overcome. For example DELL produce bespoke customer solutions from a network of distributors strategically placed around the world. Similarly, ETO companies also produce bespoke customer solutions within a lean SCI context. Christopher and Towill (2000) conclude that lean supply chains are under pressure to become agile and in some industries there is further pressure for customised delivery. However, the importance of the four areas of uncertainty must not be underestimated as these can be significant implementation problems which need to be overcome as ETO manufacturing companies strive towards becoming 'Virtual Corporations' and 'Extended Enterprises'.

Hamel (2001) argues that the only hold a business has over a customer is the combination of skill, ideas, innovation and speed of response which make the business unique. UK ETO manufacturing companies offer most of these but still need to be responsive. Soliman et al. (2001) suggest that this can be achieved by B2B enterprise integration by using modern tools such as ERP, CRM and sharing knowledge. The four prime integration concepts to achieve this are vertical integration, enterprise application integration, integration of the supply chain and customised delivery (leagile). These integration systems are generally accepted practices within manufacturing, as proposed by Christopher and Towill (2006) and should not be inhibitors to the adoption of B2B enterprise integration within ETO companies. Although the supply chain literature fully supports B2B enterprise integration practices for businesses, there appears to be a gap in its application specific to ETO companies.

### 3.1.2 Productivity and Performance: (SCI and IT)

ETO companies are not unique when making new technology investment decisions. It is normal practice for companies' key decision makers to request evidence of the forecast return on investment from new initiatives, which could have a major impact on the companies' performance. The aim of this section is to review the literature relating to productivity and performance improvement associated with supply chains and use of new IT technology

relating to B2B practices. Smith (1776) states that ultimately, productivity growth and improved business performance are considered to be the two main drivers which determine living standards, the competitive advantage of companies and the wealth of nations. Brynjolfsson and Hitt (1996) state that productivity growth is arguably the single most important economic statistic. These are important measures for businesses in general.

The adoption of B2B practices has, according to the previous sections, significant advantages and, if implemented correctly, should improve business performance by increasing productivity. The work of Brynjolfsson (1993), Brynjolfsson and Hitt (1996) and significantly Brynjolfsson and Hitt (2000) explores the relationship between IT investment into a B2B integration organisational structure and corporate performance amongst USA companies. They found that companies adopting decentralised organisational and work structures have a higher contribution of IT to productivity. Companies which are more decentralised than the industry median have an average of 13% greater IT elasticity and 10% greater investment in IT than the median company. They also found that companies above the median in both IT investment and organisational decentralisation are on average 5% more productive than companies that are above average in one or the other but not both aspects.

Similar results can be claimed by exploring the relationship between IT, organisational structure and stock market valuation. Companies in the top third of decentralisation have a 6% higher market valuation all else being equal. In addition, it was found that the stock market valuation of a dollar of IT investment was between two dollars and five dollars greater in decentralised companies than in centralised companies. The evidence at a company level shows it is the combination of IT investment and changes in organisation and work practices, facilitated by typically B2B integration systems, which contributes to companies' productivity and market value. They conclude that the effect of IT investment and organisational transformation are the main contributions to the complimentary assets of the company expressed in productivity and market value. In their view, these complimentary assets are difficult to measure and they create output changes in companies, which distort any statistical analysis within national accounts.

Similar results were found in a survey of 100 manufacturing companies in France, Germany and the United Kingdom which was conducted by McKinsey in 2005. Whilst it is recognised that IT investment can play a critical role in raising business productivity, it was found that the benefits were diluted unless they were accompanied by appropriate organisational transformation, as confirmed in earlier work by Clegg et al. (1997), which by contrast can boost productivity on its own (refer to Figure 6). From the McKinsey (2005) survey, it can be

concluded that improving management practices increases productivity more than investing in IT, while a combination of both yields the greatest increase.

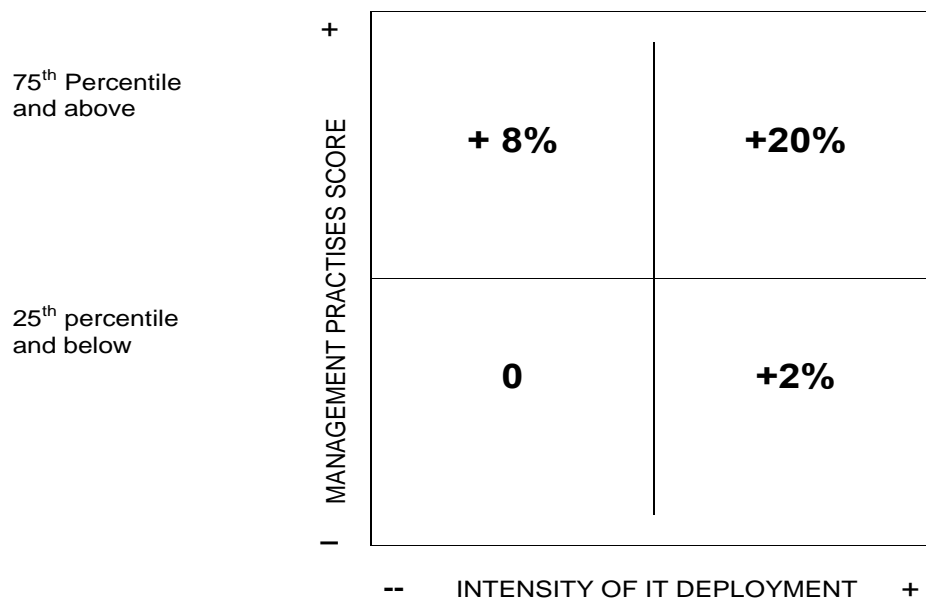


Figure 6. Increase in total factor productivity  
(Source McKinsey Survey 2005)

This is based on a rating of three important management practices amongst manufacturing companies:

- (i) Lean manufacture: elimination of waste and non-added value operations.
- (ii) Performance management: sets clear goals and rewards employees who reach them.
- (iii) Talent management: attraction and development of high calibre people.

The companies that had the highest ratings in these areas improved productivity by a combination of implementing these management practices and IT investment such as B2B enterprise integration. Early work by Benjamin and Levinson (1993) found that business performance benefits from IT were not being realised because investment is biased towards technology and not toward managing changes in process and organisational structure and culture. This continues to be a problem, as identified by Peppard et al. (2007). Barua et al. (2004) developed a model which demonstrated that businesses achieve improved financial performance by leveraging new IT technology to transform how they transact with customers, suppliers and other business partners. Similarly, Melville et al. (2004) argue that IT is valuable



but the extent and dimensions are dependant upon internal and external factors, including complimentary organisational resources of the business and its trading partners, as well as the competitive and macro environment. Recent work by Ashurst et al. (2008) concluded from their analysis that there was no evidence of benefits realisation practices being adopted in any consistent, comprehensive or coherent manner. They suggest effective benefits realisation requires an ongoing commitment to, and focus upon, the benefits, as opposed to the technology, throughout systems development and operation as found by Benjamin and Levinson (1993) and later by Peppard et al. (2007).

The CBI (2005) survey concludes that manufacturing companies in the UK achieve an extra 2.2% in productivity for each additional 10% of employees using computers. In newer (green field) manufacturing companies, the CBI claim this extra productivity effect rises to 4.4%. The CBI goes on to argue that manufacturing companies in the UK achieve an extra 2.9% in productivity for each additional 10% of employees using the Internet. The main reason for this is attributed to elimination of duplication across functional disciplines and increased user friendliness of computer equipment. However, caution should be observed with these claims because the research lacked rigour. Similarly, they claim that for newer manufacturing companies the effect is larger. In addition, the CBI states that US-owned manufacturing companies in the UK are more successful in exploiting IT systems such as B2B enterprise integration. These claims made by the CBI are complimentary to the research carried out by Brynjolfsson and Hitt (2000), who argue that improvements in productivity are due to a combination of investment in new IT technology such as B2B enterprise integration and appropriate organisational transformation. Furthermore, Frohlich and Westbrook (2001) found that suppliers and customers had improved performance significantly by having a higher degree of SCI compared to their competitors. The work of Ireland and Webb (2006) and Mitra and Singhal (2007) confirm the importance of SCI as a key determinant of value creation. This exploratory study into the implementation problems in adoption of B2B enterprise integration will investigate whether ETO companies measure improved performance, on what basis and whether they use specific models. For example, three fundamental measures of improved performance due to successful adoption of B2B enterprise integration could be:

- (i) The sales volume per employee should increase over time.
- (ii) The work in progress as a percentage of turnover should decrease over time.
- (iii) The working capital as a percentage of turnover should decrease over time.

These measures should not be taken in isolation as the only reason for improved performance attributable to B2B enterprise integration. The effect of appropriate organisational

transformation should also be considered, understood and measured. This is important when considering implementation of B2B enterprise integration.

The above are the basic benefits which have been confirmed by those attending the first world congress on the management of electronic commerce. In the review and commentary, Bontis and Castro (2000) argued that B2B transactional speed does not allow senior management the luxury of traditional strategic planning exercises. In addition, they commented that organisations should take into consideration that today's B2B virtual organisations do not adhere to traditional business models. Two core problems are identified here. The business case for B2B enterprise integration is valid, real and available for UK ETO manufacturing business to adopt. However, senior managers' traditional strategic planning and the comfort of existing business models are being challenged. Executives and senior managers should increase their knowledge and awareness of the benefits of B2B enterprise integration technology. The lack of knowledge, awareness and use could be preventing implementation of this new business concept.

### 3.2 Information Technology and Acceptance Models

Acceptance of new information technology is an important factor of realising the benefits from successful implementation for SCI between enterprises. Factors that inhibit the adoption of new technologies have been explored by researchers in various different contexts (Davis et al., 1989; Venkatesh and Davis, 2000; Riemenschneider et al., 2003; Teo and Ranganathan, 2004; Law and Ngai, 2007 and Harland et al. (2007). As a result, formal theories and individual factors have been proposed which aim to explain and predict the adoption of new technologies.

The most prevailing formal theory is the technology acceptance model (TAM) (Davis et al., 1989) and subsequently (TAM2) (Venkatesh and Davis 2000), which stems from decision theories and social psychology (Riemenschneider et al., 2003). TAM2 argues that two particular beliefs, perceived usefulness (the subjective performance) and perceived ease of use (user's subjective probability that using a specific application system will increase his or her job performance), can explain and predict computer usage behaviour (Davis, 1986; Davis et al., 1989; Venkatesh and Davis 2000). They argue that in a work environment, with a high degree of interdependence with other social actors in performing ones duties, increased status within the group is a basis of power and influence via processes such as social exchange, coalition formation, and resource allocation. By performing behaviours that are consistent with group norms, an individual *“achieves membership and the social support that such*

*membership affords as well as possible goal attainment which can occur only through group action or group membership*". They claim the increased power and influence resulting from elevated status provides a general basis for greater productivity. An individual may perceive that using a system will lead to improvements in their job performance (which is the definition of perceived usefulness) indirectly due to image enhancement, over and above any performance benefits directly attributable to system use. This identification effect is captured in TAM2 by the effect of subjective norm on image, coupled with the effect of image on perceived usefulness. TAM2 theorises that identification, like internalisation but unlike compliance, will occur whether the context of system use is voluntary or mandatory. TAM2 has since been used to explain computer acceptance in various contexts, such as free content websites (Castaneda, 2007), and tax filling (Fu et al., 2006). Most of these studies have focused on the probability that using a specific application system will increase a user's performance. The ability of TAM2 to explain the adoption of computer systems by individual users or business executives (Riemenschneider et al., 2003) used quantitative techniques to validate their hypotheses. Amoako-Gyampah and Salam (2004) found that training and project communication can increase the likelihood of successful implementation of company-wide advanced IT systems such as that required for B2B enterprise integration.

Studies that go beyond or do not consider the implementation of TAM2 often try to identify how isolated factors can affect the adoption of a new system. Factors such as the management's approach to new technologies (Bontis and Castro, 2000; Tovstiga and Fantner, 2000; Froome, 2000), its approach to risk (Attaran, 2000), the environment, a firm's structural characteristics (Bayo-Moriones and Lera-Lopez, 2007), the skill intensity needed (Rahim and Pennings, 1987; Mody and Dahlman, 1992), product complexity within supply chains (Tan et al., 1998; Christopher and Towill, 2000; Christopher and Towill, 2006), and other internal organisation factors have all been found to have an effect.

Management awareness of the benefits of the new systems may result in a higher level of commitment to their implementation as described by the work of Bontis and Castro (2000), Tovstiga and Fantner (2000) and Froome (2001). As management commitment is often cited as a key success factor when changing projects (Bingi et al., 1999), higher management awareness could increase the likelihood of implementation. In terms of TAM, higher management awareness would increase the perceived usefulness of the new systems and therefore increase their chances of successful implementation.

Perceived risk is often found to have a profound effect on the implementation of new technologies. With a few exceptions (Fu et al., 2006), most research studies have concluded

that the risk of failed implementation or the risk of the loss of data often stops both companies and individuals (Choudhury et al., 2008) from implementing new technology. It may, for instance, result in the risk of unsuccessful implementation and therefore a potential loss of investment. Similarly, integration systems often manage information such as intellectual property which is perceived as providing organisations with a competitive advantage. Therefore, the risk of a security breach to these will reduce the likelihood of the new system being implemented.

The skill intensity required to implement new integration systems is usually relatively high, according to Rahim and Pennings (1987) and Bingi et al. (1989). This is evident because a new set of skills is often needed to both implement and operate a new system. To overcome this difficulty, companies often outsource part or all of the implementation and train their staff to use it post-implementation. Despite the apparent simplicity of this process, it has often led to dissatisfaction in its implementation and use, as reported by Kumar et al. (2003) and Yusuf et al. (2006). In terms of TAM2, the required skill intensity would decrease the perceived ease of use and would therefore reduce the likelihood of successful implementation.

Businesses that are considering implementing B2B enterprise integration could overcome the potential inhibiting factors discussed above by taking cognisance of TAM2 and adopting appropriate management planning. There is no theoretical or technological reason why B2B enterprise integration should not be adopted by ETO companies due to issues over TAM2 concerns. However, it is apparent from previous research by the CBI in 2005 and the literature reviewed that problems to adoption of B2B enterprise integration exist and require further investigation. Factors identified by the CBI (2005), Ashurst et al. (2008) and Choudhury et al. (2008), which require further review of the literature, are security issues with regards to loss of intellectual property, human behaviour influences and consequences, and business continuity in the context of business risk during implementation. These are all covered in the following sections.

### 3.2.1 Information Systems Security Issues

The use of the Internet for everyday B2B transactions is bringing new threats to companies such as loss of intellectual property and increased global competition. This is particularly relevant for ETO manufacturing companies because they rely upon their intellectual property rights (IPR), trademarks and bespoke solutions to maintain their competitive edge. Connecting these together using ICT enterprise integration techniques could make this information accessible to the competition and, as such, weaken the companies' position. The

security of these Information Systems (IS) is therefore considered to be a key issue in B2B enterprise integration for ETO manufacturing companies. Research by Kokolakis et al. (2000) found that one in five organisations suffered serious breaches of security. Security policies were found to be inadequate with significant gaps between awareness of security risks and steps taken to avoid them. This research found that ICT professionals have difficulty with convincing corporate management to invest in security projects. This is because corporate management are generally locked in the payback paradigm and as a result only support projects which can provide their cost viability (return on investment). This creates a paradoxical situation, as shown below and confirmed by Kokolakis et al. (2000).

- (i) The need to integrate bespoke systems using B2B enterprise integration to provide customers with the responsiveness they require, yet they must retain their uniqueness.
- (ii) The need to protect and secure IPR, trademarks, and bespoke/tacit knowledge at all costs.
- (iii) The unwillingness of corporate management to invest in IS security because there is unlikely to be a project cost justification.

It is essential for ETO manufacturing companies to overcome this paradoxical situation by considering IS design methodologies, which address both technical and organisational issues. Kokolakis et al. (2000) propose a business process modelling approach to IS security analysis and design. They conclude that introducing security in IS is an add-on feature which appears to be common practice, which aims to reduce overhead costs. However, they recommend companies should integrate security into IS, rather than importing it as an add-on. Daniel (2001) considers that in a dangerous world, Internet security cannot be left to technologists alone – it must be a fundamental boardroom issue.

Research by Furnell and Kariveni (1999) suggests that there is a lack of awareness and understanding of the security technologies which are available. They deduce that overcoming this problem would help establish a wider foundation of trust in the new technology. Kolokotronis et al. (2002) postulate that information security is not merely a technical solution implemented at each end point of the inter-organisational application, but an integrated approach based on a rigorous, multi-level and multi-dimensional model. This as a starting point has the overall business goals and objectives. The model drives the development of a strategy from the lower levels of securing data in storage and transition to the higher levels of business processes. The BSI standard for IS management (BS7799) is a good baseline for companies embarking on B2B enterprise integration. Their overview covers the issues to be considered when selecting an appropriate ISP, as seen in Figure 7.

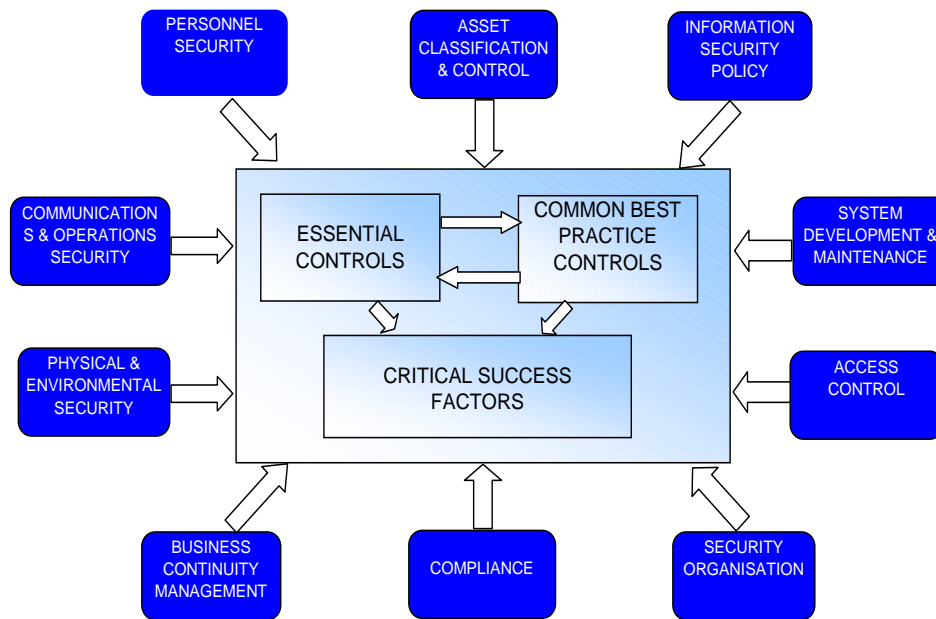


Figure 7. Issues for selecting an ISP

The important issue in the adoption of B2B enterprise integration is the essential controls required to protect IPR, safeguarding of organisational records and the protection of company confidential financial information. These have been highlighted in previous research by the CBI, in their 2005 report, as the major IS concerns of senior executives when adopting B2B enterprise integration. Other issues such as common best practice and critical success factors are in the public domain and should not present inhibitors to the adoption of B2B enterprise integration. On the contrary, essential controls are considered business specific. These should be developed, as suggested by Attaran (2000), to meet the specific demands of the business and in particular the supply chain. In the context of B2B enterprise integration this requires integration of systems between customer, manufacturer and supplier. Hence web-based interfacing. These two issues, one of dependency and the other of exposure, are in effect the corollary of the problem of ISP. While an examination of the ISP offering will hopefully lead to an acceptable degree of security in the service, the link itself places emphasis on ensuring an appropriate degree of security in the in-house facilities. Again, BS7799 can help here, usually through its application as a baseline for a review of existing practice and procedures, leading to a gap analysis and a prioritised action list. Attaran (2000) suggests that this review is conducted against an existing security policy for the in-house systems, and the gap analysis would identify threats introduced by the link which were over and above those intended to be

countered by the current security measure. However, for many companies the most practical route would be to incrementally build and review security as B2B enterprise integration initiative progresses. Depending on the model adopted by the organisation, consideration should be given to related effects. Just as the organisation is dependent on the flow of web enabled information (Power and Singh, 2007), so too might the organisation's clients be dependent on the organisation's information, as suggested by Furnell (1999). Supply chain integration (SCI) is the key phrase here, and the threat is not that viruses can quickly spread through the chain, but that information is (possibly) not provided with a consistent degree of protection throughout the chain. Where the organisation forms part of the chain, and especially where the organisations are near the top of it, the organisation should be satisfied that a common standard for security is being implemented between suppliers and customers.

It is concluded by Kokolakis et al. (2000), Daniel (2000), Attaran (2000), Kolokotronis et al. (2002) and Kenneth et al. (2006) that all companies embarking on adoption of B2B enterprise integration in an SCI context should have a realistic security policy. The key issue is that security is put into context, as proposed by Attaran (2000) and Kenneth et al. (2006) whereby the risks are identified, analysed and then appropriate firewalls put in place to protect against loss of IPR. The security aspects of businesses can be placed in the business plan, and conversely the risks can be placed in the context of the security goals. The security policy should in effect be one aspect of the B2B development plan under the umbrella of protection of business continuity.

An informed approach can be taken, as suggested by Kenneth et al. (2006). For example they state an organisation will put a firewall in place to protect an external connection and they will automatically assume that the risks have been countered. In practice, even where an independent third party has checked a gateway, unless the tests were appropriate to the perceived threats, and unless the results have been presented in an accessible form, the check may be worse than useless. As has been demonstrated in more than one case, the results may well be indicating vulnerability, but without some idea of the likely scale of the associated impact, and without a means of interpreting the vulnerability, it goes uncounted. A security policy provides the framework for interpreting these kinds of issues. As Attaran (2000) and Kokolakis et al. (2000) suggest, a balance can be made between technical and non-technical security measures. As security surveys show on a repeated and regular basis, in the majority of cases it is not the high-flying technical aspects that lead to problems. Security problems continue to arise from passwords left on pieces of paper, default accounts left accessible, *ad hoc* amendments to access rights, and careless importation of external data and/or software. Having a corporate policy on security, promulgated to all appropriate people,

could be a major first step to ensuring the flow of benefits from an investment in technology. The key to placing all of these issues in their proper context is the development and agreement of a security policy. Figure 8 summarises the key issues which should be considered in policy formulation.

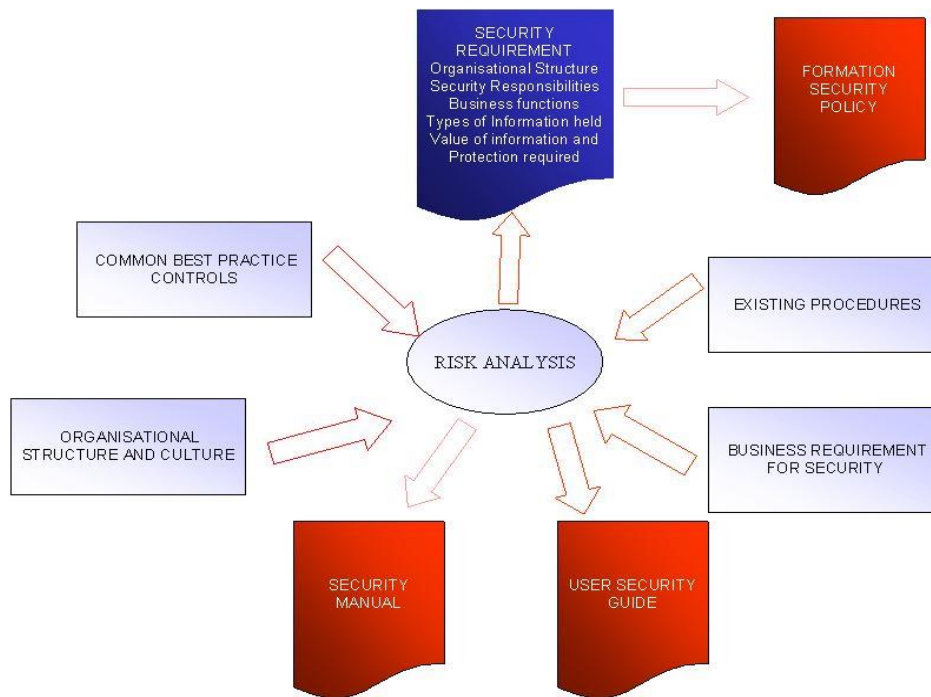


Figure 8. BS7799. Key issues for developing security policies

It is recognised that the Internet can be used by competitors and fraudsters to violate patents, trademarks, copyrights as well as pirating software. This is confirmed by the work of Jeong et al. (2011) on botnets and Pilgermand et al. (2006), Papadaki and Furnell (2006) and Al-Ayed et al. (2005) on inter-organisational intrusions. However, IS technology, firewalls and encryption techniques are considered by Daniel (2001), Kenneth et al. (2006) and Moreira et al. (2008) to be sufficiently advanced to provide the appropriate level of security. The use of memory sticks and Blackberries from 2006/2007 onwards has exacerbated security concerns. However, procedural enhancements can ensure these are used in a secure manner. Therefore, corporate management need to be aware of the security implications, the available technology and to be involved in the decision making process for IS policy. If considered appropriately, there is no reason why security issues should be a problem to the adoption of B2B practices in UK ETO companies. However, the proposed research should not overlook the concerns expressed in the CBI (2005) report on protection of IPR relating to manufacturing



businesses. As such the research will explore this as a potential managerial problem that needs to be overcome before implementation of B2B enterprise integration.

### 3.2.2 Human Behaviour: Influences and Consequences

Inappropriate consideration to human behaviour can have disastrous consequences to business performance as confirmed by research carried out by Clegg et al. (1997) and Peppard et al. (2003). New employee behaviour, work designs and forms of work organisation associated with the onset of Internet technology and B2B transactions were reviewed by Sparrow (2000) from a psychological viewpoint. It is argued that one truism on human experience is that ideas, once conceived, inevitably come to pass. B2B enterprise integration in ETO manufacturing companies is evolving. No sociobiological or technological invention or experimentation has found expression under the guise of “someone else will do it if we don’t.” The only debate about such developments is the timing of their arrival and the level of containment surrounding their impact. According to Hamel (2001), the skills required of a company to adapt to changes in technology are considered to be consistent with any business change. The single most significant difference between ‘old’ and ‘new’ is that the rate of change is at a previously unimaginable speed, as suggested by Friedman (2006). He comments that as this rate of technological change quickens, the pressures on the skills of a business to plan, project and adapt become ever greater.

Therefore, if a fast change is required, but the Internet technology only provides the technical platform, then, according to Hamel (2001), the timing and quality of preparation by the company for the coming impact is vital to the success of the B2B strategy. The decision making process and acceptance of the new models are reflected in the work of Davis et al. (1989) and Riemenschneider et al. (2003) and involve values and behaviour. Handy (1995) suggests that values and behaviour are the criteria by which decisions are made, what is good, what is bad and what is acceptable – the organisational DNA that encodes how an organisation works. Two aspects of this which are of particular relevance during the transformation into B2B are the increased power and centrality of the customer, and “*the requirement to collaborate with partners in the supply chain*” as stated by Croom et al. (2000). For example, Harland et al. (2007) identify that customers forge ahead with implementation of B2B, SCI and exert controls/pressure on suppliers to follow their lead. This practice can generate mistrust in the supply chain, as suggested by Cai et al. (2006), instead of the collaboration with suppliers that is required as researched by Ireland and Webb (2006).

To realise the potential savings of B2B enterprise integration businesses need to create an open and collaborative culture based on trust as found by Zhou and Benton (2007), Yeung et al. (2009) and more recently by Cai et al. (2010). This open and collaborative culture is required to be fluid enough to recognise that the whole supply chain includes organisations and people with differing priorities and performance drivers. Building trust and sharing information with customers and suppliers, information that was previously withheld, requires a significant change in corporate culture, as captured by Stonehouse and Pemberton (1999): *“the ability for us to do a better job in the future depends upon how well we utilise information and how well we train and mould this information into something that helps us to be more competitive.”* This requires employers to recognise the types of employees in their organisations and the level of involvement/participation they can expect.

Hollingshead et al. (1999) describe the dominant values and expectations of the post-war workforce broken down into age groups. Reference is made to Generation X (those under 30) who value lifestyle and are loyal to their peers. In addition, they value empowerment, organisational learning and self development. By comparison, the over 50s embrace hard work, loyalty to the organisation and value command, control, compliance and dehumanisation. Since most organisations have a wide range of age groups, the types of EPI require careful consideration by the management. For example, an employee over the age of 50 may find it difficult to adapt to Internet technologies compared to an employee under the age of 30. In contrast, the organisation is more likely to retain the loyalty and employment of an employee over the age of 50 rather than an employee under the age of 30, for example. It is necessary to allow Generation X to be more involved in the organisation's future decision making to retain their services.

Hamel (2001) argues that as technology changes business processes need to change to ensure returns on investments of time and money. To achieve a real competitive advantage, continuous improvements need to become part of the companies' measurement ethos and part of the companies' culture (Gurteen, 1998; Hong and Kuo, 1999). By regularly including supply chain partners in the optimisation process, this can help lock in the required behaviour and culture which make collaboration and alliances work. According to Whipple and Frankel (2000), trust must exist in an alliance since each party depends on the other to satisfy mutual goals. Under these circumstances the commercial relationship with customers and suppliers starts to become mutually beneficial rather than adversarial, with the added benefit that innovation and new business opportunities can be exploited quickly and at lower cost. Furthermore, Cousins and Menguc (2005) revealed that socialisation is essential for the

development of any significant business relationship and the enhancement of a supply chain using a B2B enterprise integration strategy.

An Internet inspired redesign of business processes will have several effects on an organisation's structure – two of the most relevant for the manufacturing industries are the front office/back office divide and the way in which the planning functions are aligned with the supply or value chain. Hamel and Prahalad (1990) propose an organisational culture based on its core competencies where non-core activities are outsourced as part of the supply chain.

The front office, or commercial side of the business, will find that a collaborative approach with customers will drive towards decentralisation, to the point at which the ideal location for a front office would be next to or even inside the customer's office. The speed and low cost of communication through the Internet can allow for effective knowledge management. Bhatt (2001) examines the interaction between technologies, people and customers. The effect on the back office or support functions is similar. The focus of manufacturing, finance, human resources and information technology will be to eliminate waste and reduce cost, not just once but continually, as proposed by Hendry (1998). Through a combination of centralisation and outsourcing, the Internet will enable businesses to become lean and agile, similar to Adams' fifth wave (2000). To squeeze the most value from a slimmed down, centralised back office, businesses have located to a low cost area or country.

It is considered by Clegg et al. (1997), Eason (2001) and Markus (2004) that the transition to B2B enterprise integration will require a fundamental change to business culture, processes and structure. As the importance of physical location decreases, the reliance on robust, simple integrated processes increases. Similarly, the culture of a business may well prevent the successful transition to a new organisation structure. It is therefore considered important to analyse how the culture has manifested itself in the business. Morgan (1997) considers culture as creating organisational reality, shared values, shared beliefs, shared meaning and shared understanding. The important cultural issues in the B2B context are considered to be attitudes towards improving ICT skills, employee generation gaps, flexibility and creativity. To quote Deal and Kennedy (1983), *"When a culture works against you it is nearly impossible to get anything done."* It is also considered essential to recognise the work of Schein (1985): *"The only thing of real importance that leaders do is create or manage culture."* Managers have an essential role to play in introducing B2B enterprise integration and reshaping culture accordingly. Human behaviour influences and consequences should not create problems in the adoption of B2B enterprise integration, providing senior management are fully aware of the

need to embrace the requirements and training needs of employees, both pre- and post-implementation.

### 3.3 Crisis Management and Organisational Learning

As discussed in previous sections, businesses today are facing a new set of strategic problems brought about by the use of technology and the Internet. Distance has become irrelevant and businesses are international. The speed of organisational change to keep pace with the highly competitive global market creates problems which are serious enough to assume crisis proportions to stakeholders, to society and could even threaten the survival of implicated organisations. Understanding and coping with crisis is a challenge for top management and organisational researchers (Smith, 1995; Reason, 1998, 2000). It is essential for businesses considering B2B enterprise integration to learn from the various theories underpinning crisis management to ensure they have an effective business continuity plan before embarking on implementation of a B2B system. The relevant literature for the theories surrounding crisis management in the context of business continuity, such as Reason (1999), Smith (1995) and in particular Turner's (1976) work on incubation/latent conditions and associated intervention strategies, will be reviewed.

#### 3.3.1 Business Continuity

In order to ensure reliable business continuity plans for adoption of new technology practises, a good awareness of crisis management and disaster recovery are considered to be critical areas of competence for managers as suggested by Smith (2001). Significant business disruption or loss of consumer confidence can threaten the ability of industrial and service organisations to provide financial benefits to their owners and employees and can contribute to national and regional economic recovery and viability. The definition of crisis management derived from Smith (1995), Reason (1998) and Turner (1976) in a business continuity context is that it is an event or sequence of events that trigger spiralling organisational failure which threatens shareholders and stakeholders' financial survival with all its socio-economic consequences. Directors and senior managers could refer to the model proposed by Reason which is described in the following section.

#### 3.3.2 Reason's (1998) Model

Reason (1990, 1998) proposes that organisations are made up of many layers, with each having inherent defence systems. These systems have become complex due to the explosion

of computer technology and the B2B enterprise integration as applied to SCI. Organisational layers and systems are now extremely complex. Reason (1998) argues that these high technology systems have a mixture of hard and soft defences. These forms include engineered safety features, such as automatic controls, warning systems and shutdowns, together with various physical barriers and containments. The latter is comprised of a combination of paper and people rules, procedures, training, administration controls and, in particular, front line operations such as pilots and control room personnel. The result of these many layers of defence is to make these systems proof against single failures, either human or technical. For a crisis to occur in such a system, it requires the unlikely combination of several different factors to penetrate the protective layers.

Reason (1998) refers to one way of representing the aetiology of an organisational crisis as the “Swiss Cheese Model”. Here, the defences (portrayed as cheese slices) are shown as intervening between the local hazards and potential losses. Each slice of cheese represents one layer of defence. In an ideal world all of these layers would be intact. In reality, however, each layer has holes or gaps. These gaps are created by active failures – the errors and violations of these at the human level – system interface – and by latent conditions arising from the failure of designers, builders, managers and maintainers to anticipate all possible scenarios. The holes due to active failures are considered to be relatively short lived, while those arising from latent conditions might be dormant for many years until they are revealed by regulators, internal audits or by incidents and failures. It is also important to recognise that, unlike the holes in Swiss cheese slices, these defensive gaps are not static, especially those due to active failures. They are in continuous flux, moving around, opening, and shutting according to local circumstances. This metaphor also makes it clear why organisational failures are rare events. For such a crisis to occur, it requires a lining up of the holes to permit a brief trajectory of the opportunity for failure.

There is also a need to distinguish between two kinds of failure, individual and organisational (Fischer, 2002). Individual failures are ones in which a specific person or group is often both the agent and the victim. These are considered to be the slices in the Swiss Cheese Model. The damage to the people concerned may be great but its spread is limited. Organisational failures occur to systems or sub-systems. They have multiple causes involving many people operating at different levels within their respective companies. Organisational failure occurs when the holes line up in the Swiss Cheese Model and this can have catastrophic consequences. The frequency of organisational failures has increased. This is considered to be due to the highly complex B2B enterprise integration systems that are being used today as confirmed by Reason (1998) who states “*Organisational failures are a product of technological*

*innovations that have radically altered the relationship between systems and their human elements”, which confirm this viewpoint and refers to concerns between systems and humans.*

Principal differences between individual and organisational failures are summarised by Reason (1998) as:

<b>Individual Accidents</b>	<b>Organisational Accidents</b>
Frequent Limited consequences Few or no defences Limited causes Slips, trips and lapses Short ‘history’	Rare Widespread consequences Many defences Multiple causes Product of new technology Long ‘history’

Anheier (1999) provides a detailed account of the various types of organisational failures and breakdowns. The particular area of concern is failure and breakdown caused by inappropriate management in the context of consideration to business continuity planning when implementing a B2B system. The research will specifically investigate the consideration of business continuity planning by senior management during the selection and implementation of a B2B system.

### 3.3.3 Incubation and Latent Conditions

Turner (1976) considers that a failure, disaster or cultural collapse takes place because of some inadequacy in the accepted norms and beliefs, but if the disruption is to be of any consequence, the discrepancy between the way the world is thought to operate and the way it does rarely develops instantaneously. Instead, there is an accumulation of a number of events that are at odds with the picture of the world and its hazards, represented by existing norms and beliefs (Preiholt, 2002). Turner calls this the “incubation period”. He outlines a six-stage sequence of events associated with a failure of foresight. The incubation period is aligned to stage 2 of his outline plan and covers the accumulation of an unnoticed set of events, which are at odds with the accepted beliefs about hazards and the norms for their avoidance. This can also be applied to situations where external warnings, such as market volatility, are ignored by those corporate executives who are resistant to change (e.g. rigid core beliefs). Failure to observe the warnings can lead to corporations losing entire market

shares overnight with a subsequent loss of business and serious societal consequences for its stakeholders (e.g. job losses).

Smith (2000) suggests that the difficulty in crisis prevention lies in the ability of organisations to surface the nature of these core beliefs. He argues they are deep rooted phenomena and rarely articulated in an open forum. In addition, he states that whilst rigid core beliefs may prove to be the foundation of the incubation process, the other factors identified by Turner (1976, 1978) are also of considerable importance.

The importance of the incubation period and its core elements in relation to B2B enterprise integration are captured by this quote from Smith (2000): “*As organisations move to become more virtual, the risk of their tangible assets becomes even more critical and Turner’s incubation elements have even greater relevance.*” It is essential that organisations overcome the barriers to learning so they can move to full cultural re-adjustment. Organisations therefore require a framework of strategies for intervention to overcome the barriers to learning which prevent full cultural re-adjustment.

#### 3.3.4 The 7Cs of Crisis Management

The link between the crisis management theory and the corporate financial failure of organisations is considered in Smith’s (1995), “*The Dark Side of Excellence: Managing Strategic Failures*”. In this work Smith quotes Pascal’s (1990) biological metaphor as a strong model. He goes on to quote, “Organisations run the risk of acute and chronic illness, or failure, and need to be managed accordingly.” He outlines a framework for crisis management in the context of business continuity, whereby the process of crisis management is circular, starting with a crisis of management, moving into the operational phase and then feeding back into the organisation via a process of legitimisation and learning. Each of these phases is driven by seven factors, which are referred to as the 7Cs of crisis management. These can be grouped into a “cold” technocratic group and a “warm” organic group.

Smith’s contention is, if attention is paid to the 7Cs within the strategic management process, that the propensity for failure within organisations will be reduced. This is considered to be a valid and relevant contention and one which can be deployed by firms who are embarking on a B2B implementation system which can provide the basis for business continuity planning.

### 3.3.5 Intervention Strategies

If management is going to learn from past mistakes and more importantly develop an organisation which is crisis prepared, it needs to avoid the incrementalist response that has occurred in previous failures. Only a holistic approach to the problems can generate effective conditions for learning to take place. The sheer complexity of modern organisations and their associated systems create management problems of emergence – where elements of the system interact to create properties that had previously been unforeseen. Breaking complex problems down into their component parts (reductionism) can generate solutions. Neglecting the impact of such interventions on the emergent properties of the system compounds the risk of further failure. However, as discussed earlier, organisational barriers may exist which prevent effective learning taking place. Elliott, Smith and McGuinness (2000) have identified a series of barriers which can impact upon organisations' abilities to learn and they offer potential strategies for intervention.

These barriers to learning are summarised as:

- Rigidity of core beliefs, values and assumptions
- Lack of corporate responsibility
- Ineffective communication and information difficulties
- Incrementalist approach to problem solving (failure to deal with emergence)
- Reconstruction of event narrative and the projection of blame
- Focus on single loop learning and a failure to address the manner of decision making
- Peripheral enquiry and the influence of the decoy phenomenon
- Centrality of expertise, denial and the disregard of outsiders
- Cognitive narrowing and event fixation (reductionism approach)
- Maladaptation, threat mitigation and environmental shifts.

In order for businesses to improve it is essential they have a culture which encourages freedom of speech, democracy and the encouragement to challenge the beliefs of their immediate superiors at any level as suggested by Coan (2002). The above crisis management theories have been developed from historical events, resulting from system or human intervention error, causing disasters involving loss of life or corporate failure. It is important for businesses to understand crisis management factors to ensure effective business continuity planning which leads to successful B2B implementation. Enough experience and theory is



available for practitioners to ensure effective business continuity planning for implementation of the B2B enterprise integration. As such, providing senior executives are fully briefed, this should not be a problem to implementation.

### 3.4 Implementation Success Factors

There have been a number of studies into the critical success factors for the implementation of new IT technology systems which can be considered of interest in relation to the adoption of B2B enterprise integration such as Clegg et al. (1997), Foo et al. (2000), Nah et al. (2001), Kumar (2003), Peppard et al. (2007) and Harland et al. (2007). In particular, studies relating to the integration of CAD/CAM with ERP systems are of interest to ETO manufacturing companies. The top level success factors for B2B integration are adequately covered by Damanpour (2001). These are as follows.

#### 3.4.1 Execution and Demand Fulfilment

This factor is the infrastructure for the development of other components and managerial success. B2B and websites should aid the demand driven production process via the E-marketplace, E-catalogues and bidding systems (online auctions). This should assist in creating an open sourcing environment. The result would cut the time between demand and fulfilment and connect the supply chains to websites. It also improves and facilitates communications, interactions, and services. Experts consider Internet and web connections to be service driven factors with an emphasis on 'services' over 'products'. Meeting customer demand is considered to be crucial and necessary for the fulfilment of obligations. Under this system, companies serve the market as one and customers, employees and partners are all treated individually. It provides a framework for collaboration.

#### 3.4.2 Collaboration

This emphasises the partnership with the trading community and identifies the most valuable potential partners. The corporation succeeds when management develops dynamic and just in time collaboration attitudes and responsiveness. Flexibility becomes an important factor because firms need to develop custom solutions and increase global competition. These need to be done at lightning speed and with seamless integration of components and supply chains, which is similar to the agile models proposed by Adams (2000).

### 3.4.3 Flexibility and Speed

Speed refers to conducting business in 'Internet Real Time' – quick, accurate and flexible at the same time. It requires the architecture of a technical business model, a business interaction system, and an integrated and flexible specific project strategy. Meanwhile, companies need to keep track of the competition, think globally and be radical with new, proposed business concept innovation models, similar to those proposed by Hamel (2001).

To achieve the above, ETO manufacture companies must consider these top level critical success factors at the same time and within a long range business planning strategy. As discussed previously, the Internet does not recognise boundaries; therefore, it is important for companies to consider the cultural and social implications of their actions, products and services, as described in the previous section.

In addition to the above, ETO manufacture companies need to consider other critical success factors with regards to integration between CAD/CAM and ERP systems, intelligent manufacturing and world class manufacturing techniques. Soliman et al. (2001), Meziane (2000), Hendy (1999) and Nah et al. (2001) describe the critical success factors for these in detail.

Soliman et al. (2001) cover research into the critical success factors between CAD/CAM and ERP systems. They develop a set of eight hypotheses to assess the degree of success of CAD/CAM integration with ERP systems. It was found that two situations generated two different sets of success factors.

The two situations were:

- (i) When an organisation acquires CAD/CAM after it already has a functioning ERP system; or
- (ii) When the organisation implements the ERP system after it has a fully operational CAD/CAM system.

They concluded that the eight hypotheses could be developed further for identification of strategies to give guidance on successful integration. However, caution should be observed because Kalakota (1997) argues that not all CAD/CAM and ERP systems are ideal candidates for successful integration. Nah et al. (2001) criticise the difficulties encountered and the high failure rate when implementing ERP systems. They argue that research on critical success

factors is rare and fragmented. In their research they conclude that eleven critical success factors for ERP implementation need to be considered.

In an ETO business, it is necessary to continuously reconfigure products and their associated manufacturing techniques. Traditional approaches to manufacturing are not considered to be responsive enough to meet global demands. It is therefore of interest for ETO businesses to consider artificial intelligence (AI) as a means of intelligent manufacturing. Meziane et al. (2000) researched the current developments and future prospects of AI in manufacturing. Their research confirms that AI is at an early prototype stage and therefore it is outside the scope of this research. However, the measure of success for any B2B enterprise integration system will be in its ability to eventually become connected to and function with AI manufacturing systems, and it is therefore worthy of note.

At a basic level, ETO manufacturing companies rely upon the tacit knowledge of the shop floor workforce. Where this occurs it is important to have world class manufacturing (WCM). Hendry (1999) outlines the problems and a set of solutions when applying WCM to make to order (MTO) companies, which are considered to be applicable to ETO companies. The emphasis is on the elimination of waste and changing mindsets to lean thinking. Evidence suggests that a change to lean thinking results in downsizing and subsequently a loss of human assets as confirmed by Witteloostuijn (2003).

Furthermore, Witteloostuijn (2003) identifies that human assets are fundamental to creativity which is an important contributor to improved performance. It is therefore critical to avoid discarding the input of human assets and organisational issues in lieu of technology-driven systems as identified by Peppard et al. (2003), Eason (2001) and Doherty et al. (2003). Their research identifies that the key critical success factors in the adoption of B2B enterprise integration are the effective management of employee skills and their buy-in to the new systems and work forms.

### 3.5 Literature Summary, Gaps Identified and Proposed Research Question

The aim of this chapter was to review the extant literature and identify any gaps relating to the implementation of B2B enterprise integration by ETO manufacturing companies. This section summarises the key literature, discusses the gaps identified for study in the research and concludes with the research question.

**3.5.1 Supply chain considerations**, with particular reference to product complexity and uncertainty in demand/processes and suppliers. The work of Tan (2001), Christopher (1998), Towill (1997), Flynn et al. (1999), Harrison and Van Hoek (2008) and Flynn et al. (2010), on synchronised supply chains have demonstrated the viability of B2B integration in relation to mass produced commodity products. Their work is important in relation to ETO companies. However, significant implementation problems can arise with unsynchronised supply chains, demand/process uncertainty and product complexity. In this regard the literature reviewed does not provide sufficient knowledge on how these practices can be applied to ETO companies. This gap needs to be explored in the research in the context of ETO companies B2B practices and their strategic decision making at executive level on implementation of B2B integration within supply chains.

**3.5.2 Lack of executive knowledge and awareness** in the measure of improved productivity and performance with regards to adoption of B2B enterprise integration practices (e.g. Brynjolfsson and Hitt (2000)) has been identified in the literature as an issue. ETO companies require evidence of the return on investment and business benefits in adoption of new technology systems. The work of Ward et al. (1996), Peppard et al. (2007), Ashurst et al. (2008) and Flynn et al. (2010) identifies issues surrounding benefits realisation from IT investments such as B2B enterprise integration. The literature clearly defines the benefits in productivity and performance when a firm implements B2B enterprise integration. However, previous research has found manufacturing companies in the UK to be slow in adoption of this technology. If the performance benefits are clear, the reasons for the perceived slow adoption need to be explored in the research at executive decision making level.

**3.5.3 Information security** is a major concern to all businesses and is confirmed by the work of Attaran (2000), Morris et al. (2000), Kolokotronis et al. (2002) and Kenneth et al. (2006). This is considered to be particularly important for ETO companies because their niche market positions are directly related to protecting their bespoke product IPR, certification and knowledge. However, the literature and in particular the work of Kolokotronis et al. (2002), Papadaki and Furnell (2006), Moreira et al. (2008) and Jeong (2011) suggests that security is not seen as a roadblock to B2B enterprise integration; rather it has to be managed. However, the literature does not identify how ETO companies can manage their IPR and bespoke systems whilst having the benefits of seamless B2B integration. This gap needs to be explored in the research at executive and senior management level and in particular the role and influence of IT managers.

3.5.4 **Human behaviour** and the new forms of work organisation as a consequence of downsizing organisations due to the introduction of new technology are major factors in the adoption of B2B integration. The work of Clegg et al. (1997), Hollingshead et al. (1999), Witteloostuijn (2003), Eason (2001), and Melville (2004) is considered to generally apply in this context but is not specific to ETO companies. How ETO companies manage the introduction of new technology such as B2B enterprise integration in terms of employee issues such as retention/redundancy, re-training and recruitment is not covered in the literature. This gap will be of interest to this research in understanding the implementation problems within ETO companies and how they can be overcome.

3.5.5 **Crisis management factors** with regards to business continuity planning, disaster recovery and organisational learning for implementation of new technologies are all covered by the literature. The work of Smith (2000), Reason (1998) and Turner (1976) is particularly relevant because of the history of organisational failures using complex IT systems such as B2B enterprise integration. However, the literature reviewed does not cover business continuity issues pre- and post-implementation of B2B integration relative to ETO companies. For example, do ETO companies have a business continuity monitoring function in place, which will ensure that changes to risks and vulnerabilities are monitored as the importance of and dependence on B2B enterprise integration increases? This gap requires investigation during the research.

Gaps in the literature have been identified relating to executive knowledge and awareness, realisation of business benefits and organisational issues which could explain the reluctance of executives and senior managers to fully adopt B2B enterprise integration. The literature reviewed and previous research does not provide appropriate models to overcome these problems. As such, there is insufficient knowledge available to ETO practitioners and a lack of implementation models to overcome these problems.

The research question proposed is:

***“What are the managerial problems concerning implementation of B2B enterprise integration practices in UK ETO manufacturing companies and how can these be overcome?”***

The next chapter will present the philosophical and methodological considerations that will underpin the proposed research.

## CHAPTER 4 – RESEARCH METHODOLOGY

This chapter defines the research question, and provides a discussion on alternative research methodologies and a description of the methodology adopted. It then describes the interview format, key informant questions and potential issues. It follows with a description of each phase of the research, selection of the participating companies, the problems of access and how they were overcome. It concludes with a description of the techniques used for the analysis and a summary of the chapter.

### 4.1 The Research Question

The new forms of business models using B2B enterprise integration provide a platform for innovative companies to extend their geographical territories and achieve significant benefits in performance. According to Friedman (2006), IT systems are sufficiently advanced for ETO companies to adopt B2B enterprise integration. The literature review confirmed that computer technology is sufficiently advanced and the business benefits clearly defined for ETO manufacturing companies to adopt these practices. However, previous limited studies have identified that adoption of B2B enterprise integration practices is slow amongst ETO manufacturing companies in the UK. Gaps in the literature review have been identified covering managerial issues concerning a perceived lack of executive knowledge and awareness, strategy and control, supply chain issues, performance benefits, information security, human behaviour, and business continuity. These are considered by the researcher as implementation problems concerning adoption of B2B enterprise integration which should be overcome given the advances in computer technology. Therefore, the primary research for this exploratory study is concerned with investigating the managerial issues at executive/senior management level which need to be understood and overcome within the UK ETO manufacturing companies. This exploratory study sets out to answer the following question:

***“What are the managerial problems concerning implementation of B2B enterprise integration practices in UK ETO manufacturing companies and how can these be overcome?”***

To answer the latter part of the question, the research will be designed specifically to develop a B2B integration hierarchy, with a proposed model for implementation, appropriate to ETO companies.

## 4.2 Alternative Research Methodologies

Several research methodologies for investigating managerial behavioural issues have been used successfully by researchers in the past. These include participant observation, direct/structured observation using diary studies and other materials, personal interviews, and postal questionnaire survey methods. There are advantages and disadvantages with all of these methodologies and it was not immediately obvious which of them would be appropriate for this type of study. On the one hand, small numbers of respondents investigated in depth over time might yield valuable qualitative materials and insights but problems of generality, validity and reliability would have to be faced. On the other hand, a large postal survey would provide quantitative data, which could be investigated statistically. However, such research would necessitate adopting a precise perspective at the outset and would primarily be verification rather than an exploratory study. Various combinations of these and other techniques could have been exploited but a danger of attempting too much would be the risk of diluting effort and not achieving a sufficiently substantive result. The argument against 'remote' questionnaire methods is that, used alone, they don't provide information about inter-organisational social dynamics between managers. Furthermore *"practitioners in many fields of research often view questionnaire studies as superficial and the abstractions of quantified material and statistical correlations as very remote from everyday practice and, therefore of little use – at least when dealing with human aspects of organisational life"*, as stated by Alvesson and Deetz (2000). The research question "What are the managerial problems concerning implementation of B2B enterprise integration practices in UK ETO manufacturing companies and how can these be overcome"? led one to an exploratory study into the managerial issues and tensions within the organisational setting to surface the issues by carrying out interviews with key informants within an organisational setting. Therefore, it was decided to adopt a two-phase qualitative methodology approach using a combination of interviews (case studies) and an in depth case study. The role of phase one interviews would be to surface the managerial problems and propose an implementation model to overcome them. Phase two case study would test and refine the implementation model. The decision was influenced by previous research relating to the slow adoption of B2B enterprise integration and the type of gaps identified in the literature review (see Chapter 3). Based on this, it was considered essential that executives and senior managers responsible for setting B2B enterprise integration strategies in ETO manufacturing organisations would form the basis for research using them as informants.

The problems of managerial study by interviewing informants are well known and highlighted by Mintzberg (1973). Opting for an interview programme meant taking on board these

problems. However, it was considered possible to gain reliable information if suitable precautions were taken. An approach which involved interviewing key informants at one organisation was not considered appropriate, because according to Mouzelis (1967):

*“It is obvious that however ingenious the research is in one organisation, we can never be sure of their generalised validity. On the contrary, we can be almost certain that such research is only valid under certain conditions and for certain types of organisation. This being the case, the only way to find out what these conditions are is by the appropriate comparison of more than one case.”*

The two-phase approach proposed would overcome these issues. Phase 1 would comprise case studies at a number of organisations by interviewing key informants in an organisational setting. The number of organisations needed to be such that the requirements of Strauss (1978) and Miles and Huberman (1994) were fulfilled. This would investigate issues at an executive/managerial level on strategic problems concerning adoption of B2B practices. However, it may not surface other managerial factors that would arise from direct participation in a B2B implementation programme. Therefore, phase 1 research would be used to surface the problems using key informant interviews at a selected number of ETO companies. Analysis of the informant interviews would be used to develop a B2B integration hierarchy and a proposed model for implementation. Phase 2 would include a full case study at one company during implementation of a B2B project to validate the B2B integration hierarchy developed from phase 1 and refine the implementation model. The phase 2 case study would provide additional benefit and rigour by directly participating and observing senior managerial and employee behaviour within an organisational setting, undertaken over an extended B2B implementation period and encompassing the whole of a budget cycle. The value of this method is that the researcher directly observes aspects of decision behaviour relating to B2B implementation and use, thus providing reliability. The participatory action method would enable the viewing of interactions, which affected the implementation process; this would involve significant meetings, relevant chance remarks and influences from a host of different directions. The observer could be present at important events. The observer would be able to step in and ask what the consequence of an interaction would be. The problem with interviews alone of course is that the informant could suppress, be unaware of, or be unable to articulate, crucial material. Clearly, some variables are better measured by observation and others by interview or different techniques. The choice of measurement method must suit the variable that is to be measured. At an exploratory level, interviews at a number of organisations (providing they are well prepared and appropriately conducted) followed by a participant in-depth case study at one organisation would be the most appropriate method to generate



reliable and insightful material at the level of executive and senior managerial research proposed here. This approach is validated by Dainty (1983) and Denzin and Lincoln (2000).

#### 4.3 Research Methodology Adopted

The research question is considered to relate directly to the strategic decisions made between corporate directors, business unit managers, ICT managers and the external/internal organisational forces facing companies when deciding on new technology implementation. These separate functions are actively involved and inextricably linked in the strategic decision making processes regarding business performance, business improvement and the adoption of new technologies such as B2B enterprise integration. The adoption of a two-phase research strategy to interview these key informants, followed by a case study at one company, was considered by the researcher to be the most appropriate for this exploratory study. This case study could also be used for validation of any findings from the key informant interviews.

The purpose of the interviews was to understand the executive and managerial relationships, decision making and forces affecting business performance in adoption of B2B enterprise integration, in particular, the problems with adoption of this practice. Figure 9 illustrates the potential tensions and forces surrounding senior management caused by differing ontological and epistemological perspectives regarding business performance and what is important with regards to business improvement and the adoption of new technologies.

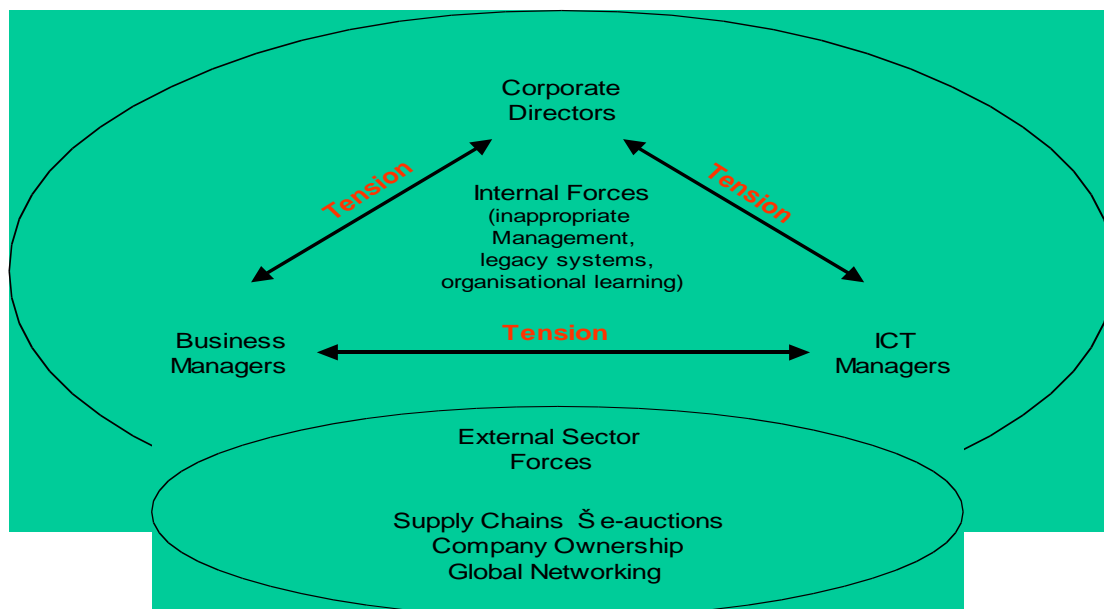


Figure 9. Perceived organisational issues: B2B enterprise integration

Based on these potential inter-organisational issues and the discussion on alternative methods in the previous section, the approach adopted would be a series of interviews, with key informants using open-ended questions with senior managers and directors at a number of UK ETO companies, followed by a case study over a full year budget cycle at one of the ETO companies. The interviews would be used to create a database of informant transcripts, which would be used to identify any problems that the companies experienced related to the adoption of B2B enterprise integration. In addition, reference was made to the companies' financial statements over a four-year period to confirm the informants' claims of performance improvements due to implementation of B2B enterprise integration.

The interviews were carried out in strict confidence. This approach, whilst having a series of prompt questions, enabled the informants to express their response on their own terms and this was considered a key factor in achieving “*qualitative depth by allowing informants to talk about the subject in terms of their own frame of reference – drawing upon ideas and meanings with which they are familiar*”, as suggested by May (1997). This allows the meanings that individuals attribute to events and relationships to be understood in their own terms.

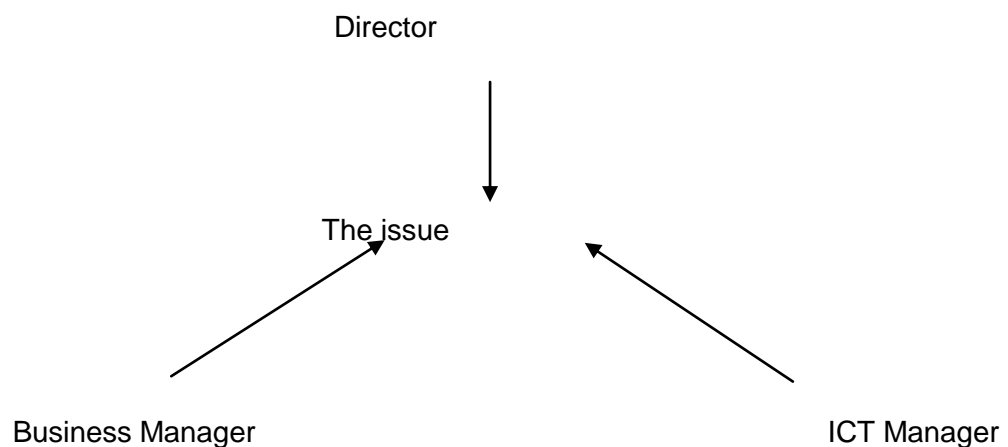


Figure 10. Group Triangulation Method

This triangulated group approach provided a balanced analysis, as proposed by Silverman (2001). It was considered to be the preferred methodology for highlighting the embedded cultural beliefs and social dynamics to be found in organisations that are in the process of, or have already implemented, B2B enterprise integration. The approach raised the informants' ontological and epistemological perspectives in the context of the research question regarding the problems in the adoption of B2B enterprise integration.

There are three common sources of error in the type of research proposed which required consideration. Denzin and Lincoln (1994) highlighted these as respondent behaviour, the wording of questions and the questioning technique.

*Respondent behaviour* – the ‘seeking to please’ or ‘hiding issues’ from the interviewer: When using this type of interview technique, trust is considered an important factor, as suggested by Easterby-Smith et al. (1991). This was not considered to be an issue in the proposed research because the interviews would be carried out in strict confidentiality.

*Wording of questions* – it was important to ensure that the interviewer sought to clarify any questions from the informants and that he/she did not indirectly suggest the response. A pilot study tested the conciseness of the questions and those areas where clarifications were required to ensure consistency.

*The questioning technique* – this covers concerns regarding interviewers using flawed techniques by using their own reference frame on the informants, both when the questions are asked and how they are interpreted. In addition, there is a danger that the interviewers might express a perception of what is best and worst which could encourage informants who have a desire to be at the better end. The design of the questions sought to alleviate this problem and one interviewer was used throughout to ensure the consistency of the questions.

The above phase 1 interview database, coupled with the phase 2 in-depth case study at one of the companies, was considered to provide rigour and validity for this exploratory study into B2B enterprise integration within UK ETO companies.

#### 4.4 Phase 1: The Interview Procedure, Key Informant Questions and Issues

The method of interviewing key informants by using long-hand notes was considered an option because it would avoid microphone shyness. However, the informants’ responses can be pre-analysed to some extent by the nature of the note-taking process and this could have led to bias. Another problem is the difficulty of noting down the response to one issue while simultaneously choosing the next topic for discussion. In contrast, the disadvantage of tape-recorded interviews is that informants can sometimes talk rapidly and crucial points could be missed. However, the researcher adopted an approach that used a checklist to ensure responses to the questions were clear and if not they were followed up for clarity. Therefore, it was decided following several practice tests and piloting with colleagues to adopt the use of tape-recorded interviews. The procedure for the key informant interviews comprised a tape-

recorded semi-structured discussion based on a series of open ended questions. Reference was made to Gorden (1969) and Seldon (1984) with regards to refining the interview technique, but it was found that experience of the interview situation itself substantially improved the quality of data collection. Finally, the researcher would observe improved efficiency in the interview process as experience and insights were gained. This could prove to be favourable for the participating companies but laborious for the researcher when preparing the transcripts. However, the outcome would provide a rigorous grounded database. Where applicable and access permitting the researcher would examine the B2B implementation process followed to assess any performance change following adoption of this technology.

From the literature review summary and gaps identified in chapter 3, a series of interview questions were compiled to cover the five issues raised:

Supply Chain Issues; Strategy and Control

- ***Who is responsible for IT strategy and how does your company view the importance of SCI?***
- ***Where would you position your company on this development map?***

Executive Knowledge and Awareness'; Business Performance

- ***What is your understanding of B2B enterprise integration?***
- ***What aspects of your business have been affected by this technology and how do you measure the performance improvements where this technology had been introduced?***

Information Security; Management of IPR

- ***How is security, for example intellectual property and confidentiality etc., managed within your company and its supply chain?***

Human Behaviour; Management of New Technology

- ***What significant changes occurred during implementation and how did you manage the introduction of this technology in terms of employee issues such as redundancy, re-training and recruitment?***

Crisis Management; Business Continuity, Risk and Vulnerability

- ***What is your disaster recovery plans to ensure business continuity during implementation of new technology and what is your organisational learning process if the systems fail?***

The interview questions were piloted with work colleagues and then with managers in two of the participating organisations. During the pilot interviews it became apparent the questions needed to be shorter and focussed, because the informants only answered part of the questions and had to be reminded several times, which made the interview process cumbersome. Following discussions with colleagues and informants, the questions were refined and re-tested. The outcome preferred in the final pilot interviews was a set of eleven open-ended questions as follows:

- ***How would you define B2B enterprise integration from an ETO perspective?***
- ***What is your understanding of B2B enterprise integration in the context of your company?***
- ***Who is responsible for formulating the ICT strategy?***
- ***What is the process?***
- ***What aspects of your business have been affected by this technology?***
- ***How do you measure the performance improvements where this technology has been introduced?***
- ***What significant changes have occurred?***
- ***How is security, for example intellectual property rights, and confidentiality etc., managed within your supply chain?***
- ***How have you managed the introduction of this technology in terms of employee issues such as retention/redundancy, re-training, recruitment and performance measures?***
- ***What are your crisis management plans to ensure business continuity in the event that this technology fails?***
- ***Where would you position your business on this B2B development map?***

The B2B development map, which is based on Adams (2000), is shown on Figure 14 page 100. These questions identified each informant's belief regarding the level of adoption of B2B practices in the participating companies and their reasons why these practices' had been applied. The sequence of topics and questions was designed to follow a logical flow, but informants frequently introduced topics themselves so the interview would be allowed to proceed in the informants' own sequence as far as possible, relying on a checklist to ensure that all the appropriate ground had been covered. Each interview was scheduled to last about one and a half hours. Occasionally an informant would continue talking after this time, but it was more usual that he was very conscious of the approach of the end of the session and of his next appointment. The researcher ensured a response was provided for each question.

Inevitably in some instances the researcher's control over the interview situation was somewhat limited. However, tape-recording the interviews did have the effect of allowing the researcher to persevere until a response was given for each question.

As alluded to above, the interview situation was not always a straightforward one. A detailed account of the methods employed and some of the difficulties encountered has been given in an earlier methodological paper (Martin, 1985). One interesting aspect was the failure of some informants to follow the conversational "chain rule" (Denzin, 1978) and those executives would not give the floor back to the interviewer. This required the researcher to cut in on a monologue, not always an easy thing to do with a managing director of a multi-million pound organisation. However, the main problem was the perspective adopted by some informants:

*"Managers tend to censor their reports of activities to show themselves in a good light. Activities and behaviours, which reflect unfavourably on a manager, are "played down". Thus, defensiveness operates to reduce the accuracy of self report data concerning activities which managers... think contradict what is expected of them". (McCall et al., 1978)*

The same could equally be said of their desire to present the company, as well as themselves, in a good light. With the top management informants this was often a significant issue. In many instances the topic under discussion was the manager's failure (and some saw it as that) to adopt B2B, at a time when computer use has very significant cultural overtones associated with it. So, certain parts of the interview uncovered emotive issues. The outcome was that some managers exaggerated their B2B knowledge and involvement; for example, the director of a large multi-national implied that he used a particular messaging system to communicate directly with his board colleagues. Unfortunately, his IT manager had already revealed that the system was discontinued two years ago, thus making this claim technically and physically impossible. Another respondent implied extensive direct use of messaging systems, when in fact questioning revealed that it was his secretary who was directly using the system. Other respondents extensively discussed the systems which they were "about to have installed" or had used in the past, which made exploration of their present use very difficult indeed. In general, topics had to be probed in some depth in order to establish a realistic picture.

*"A participant can fabricate "tales of self" that belie the actual facts, and the other party lacks objective evidence to counter such tales." (Denzin, 1978)*

The researcher took a sceptical approach to assertions of B2B use and invited respondents to demonstrate factual aspects of their activities. Wherever possible, informants' evidence was checked and compared with the others in the company and in any event they were questioned very carefully about any claimed B2B use. An example was the manager who spent some time in the interview describing the attributes of a system which was available to him. When questioned closely about his use it transpired that his description was what he had been told by his system providers, and did not reflect his own personal experience at all (he finally admitted that he had made no use of the system he had described). This informant's interview data had to be abandoned altogether. The cross-checking approach ensured the reliability of managerial claims of B2B use.

Another problem was the range of informant communication skills which affected the way they responded to the questions. An example would be the contrast between an IT manager whose description of aspects of B2B use included some masterly and convincing statements, compared to some of the business managers who found difficulty in either thinking about or articulating the issues under discussion. In one company the informants' accounts were simply not comparable. That some informants were significantly more articulate than others was not necessarily anything to do with intelligence or other personal attributes. It was probably related to their knowledge of B2B enterprise integration, the questions for them to consider and react to and because they themselves had not previously considered B2B practices in the context of the questions during the interview.

The issues discussed above are not to denigrate the informants, many of whom gave superbly reflective and helpful responses and all of whom gave their precious time; rather, it is to emphasise that there was a significant problem, one which will affect all researchers who investigate similar areas, and one which has been carefully addressed in this study.

#### 4.5 Phase 2: B2B Implementation Case Study

During the interview phase of the study, one of the companies was in the process of embarking on implementation of a B2B enterprise integration system. The researcher was invited by the company to observe senior management and to participate in the continuous improvement B2B implementation team. The owner of the company offered the researcher the opportunity to observe the decision making processes at board and senior management meetings throughout the implementation of B2B enterprise integration over a full year budget cycle. This enabled the researcher to adopt the principles of participatory action research proposed by Denzin and Lincoln (2000) to cover the interaction between the key decision

makers and the actions/behaviour of the implementation teams. The researcher who researched the phenomena discussed by Denzin and Lincoln (2000) was overcome by not informing the board, senior management team and implementation teams that the researcher's involvement was part of a research project. In essence, the research was done covertly with only the owner of the company being aware of the research project. This ensured team participants were behaving and reacting in their normal working social environment and were not 'acting out' to meet the expectations of the researcher. Bias was mitigated by the researcher being part of the team to share experience and knowledge but not to be directly involved in or influence the decision making process which was controlled by the operating board.

This was considered to be an excellent opportunity to provide additional rigour through a detailed case study by participatory action research and to validate the findings from the key informant interviews. This case study followed the implementation of B2B enterprise integration during a full budget operational cycle. The owner allowed participation in board meetings, management reviews and full access to the functional departments. The data collected and used covered minutes from the monthly board meetings, the weekly B2B project team reviews and the weekly operations meetings. Weekly one-to-one discussions were held with the Finance Director, Operations Manager and IT Manager. The researcher participated in B2B action teams and the monthly review of key performance indicators with the company owner.

#### 4.6 ETO Market Forces and Selection of Participating Companies

As discussed in Chapter 2, the ubiquity of the Internet has provided a platform for businesses to radically rethink the way they operate. Distance and geographical boundaries have become irrelevant. Businesses can obtain goods and services to support their offerings from a global market. The key to taking advantage of the global market is concerned with the benefits that can be derived from improving performance by adopting B2B enterprise integration, e.g. the ability of an organisation to be responsive in a seamless supply chain, more commonly termed 'leagile'.

There are a relatively low number of UK ETO companies which provide a limited degree of supplier concentration. From a purchaser's perspective this limits choice and competitiveness. For example MOD purchasers are typically commercially and technically knowledgeable and in some segments actually have power themselves through to promote competition or use government pressure. However, in general, buyers have limited opportunity to promote



competition in the ETO sector. Therefore, they use other means such as supply chain collaboration or profit sharing incentives to reduce the cost base. ETO companies attempt to benefit from this market condition by promoting long-term agreements and customising or specialising products and services to protect their competitive position.

The ubiquity of the Internet has meant that UK ETO companies can participate globally. B2B enterprise integration should enable ETO companies to streamline business processes and promote seamless supply chains to customise their products and services. However, lead times continue to be eroded and as a consequence ETO companies are becoming increasingly aware that to serve a global market it is insufficient to only have a UK manufacturing base. Therefore, ETO companies are introducing localisation by developing contractual relationships with representatives and license agreements with similar companies in other countries. These relationships rely upon a high degree of trust, co-operation and above all a win-win scenario. The disadvantages of these types of global alliances are described by Whipple and Frankel (2000). However, for ETO companies to thrive in a global economy, they need to understand cross-cultural barriers and develop a set of ground rules for profitable co-operation to occur using the new business models emerging from B2B enterprise integration.

Operating in a global economy with localised manufacture facilities affords UK ETO companies to gain a competitive edge by having the opportunity to introduce price segmentation. This can be used to improve product margins or create a barrier to entry for local emerging competition. B2B enterprise integration is a fundamental prerequisite for ETO companies to operate on a global stage which is becoming “flatter” (Friedman, 2006).

Public policy regarding deregulation and regulation fundamentally affects a company's performance measures. For example, a nationalised company would concentrate on the quality of products and services it provided for consumers. There would be less emphasis on profitability. In contrast, a plc's emphasis would be on increasing shareholder value by striving to maximise profitability. Venture capitalist ownership has a reputation for asset stripping. It is therefore important for ETO companies to understand their position in this regard. Roberts (2003) discusses how engineering concerns sold profitable assets when under pressure from a credit squeeze and vanishing customers. This has been exacerbated by the banking collapse and subsequent recession in 2008.

The important observation from this discussion is that ETO companies are pressurised into price reductions from customers and their privileged supply chain positions are challenged.

Hence, there is a need for ETO companies to introduce new innovative business models such as B2B enterprise integration to take advantage of the proven benefits of this technology. Therefore, it was considered important to select participating ETO companies from different industry sectors and that facilitate each other through supply chains.

The industry sector(s) now comprise of ETO companies that are attempting to introduce B2B enterprise integration throughout their complex supply chains. Therefore, identifying and defining a single industry sector to select ETO companies to participate in this research was considered inappropriate. This is because B2B enterprise integration involves the integration of not only the internal business processes, but also seamless integration across the entire supply chain, as proposed by Porter (2001). Buckley (2001) confirms this by his definition, “*e-business is about B2B transitions using electronic tools as a means to an end for product customisation in a seamless chain from raw material to end user.*” It is therefore considered essential that research involving UK ETO manufacturing companies should take account of the industry sectors and the complex supply chains this creates. In this context, the following supply chain framework is proposed based on the London Stock Exchange sectors.

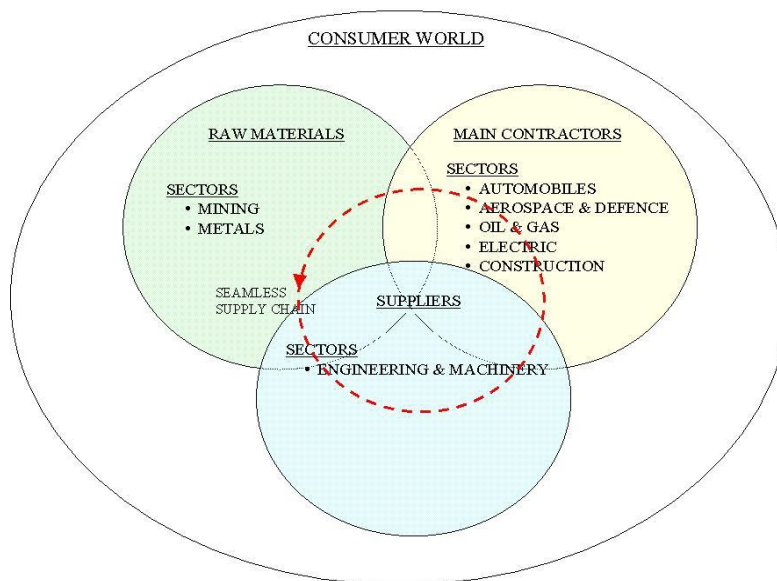


Figure 11. Supply Chain Framework – ETO Companies

ETO manufacturing companies rely upon political and economic conditions prevailing in the steel and other metals sectors to acquire supplies of raw materials. Similarly, they rely upon the propensity of consumers for the demand of their products via the industry sectors identified. In turn, the propensity of consumers is dependent on international, national and regional, political and economic conditions. The relationship between supplier, producers, customers and consumers, including their industry sectors is inextricably linked. It is therefore

considered necessary to analyse the engineering and machinery sectors across other LSE sectors. The following table lists typical ETO companies and identifies their corresponding industry sector, including the type of ownership. These companies are inextricably linked in the supply chain framework identified above. Each of these companies was approached to participate in the research.

Typical ETO Companies	London Stock Exchange Sector	Product	Ownership
Airbus UK	Aerospace & Defence	Aeroplanes	Public
BAE	Aerospace & Defence	Submarines	Public
Rolls Royce	Aerospace & Defence	Gas Turbines	Public
Siemens	Engineering & Machinery	Gas Turbines	Public
Cummins	Automobile	Diesel Engines	Public
Weir	Engineering & Machinery	Valves	Public
Moducel	Engineering & Machinery	Air Control Systems	Private
Mechtool *	Engineering & Machinery	Modules	Venture Capitalist
Darchem *	Engineering & Machinery	Thermal Protection	Venture Capitalist
Alstec	Engineering & Machinery	Turbine Components	Public
Rotork	Engineering & Machinery	Actuators	Public
Strachan & Henshaw	Engineering & Machinery	Weapons Equipment	Public
Vosper Thornycroft	Aerospace & Defence	Minesweepers	Public
BEL Valves *	Engineering & Machinery	Valves	Private
Bettis *	Engineering & Machinery	Actuators	Private
Swan Hunter	Aerospace & Defence	Surface Ships	Public
Babcock Defence	Aerospace & Defence	Surface Ships	Public
Peter Brotherhood	Engineering & Machinery	Generating Equipment	Public
Morgan *	Automobile	Cars	Private

\*Companies that are considered to be part of the engineering and machinery sector but not stated in the LSE.

A positive response was initially given by all the companies, but after further dialogue and, in particular the requirement for tape-recorded interviews, two of them declined to participate. Nevertheless this was still considered a good response.

#### 4.7 The Problems of Access and How They Were Overcome

In practice, the selection of managers and companies proved difficult owing to access difficulties encountered in most of the companies contacted. It was necessary to gain access to informants from various points of the adoption cycle, as well as from companies, which represented a reasonable sample of organisational sizes and types. Both these constraints are necessary concomitants of the theoretical aspirations discussed earlier, in order to generate theoretical insights with general validity. In the event, gaining access to managers at the right level proved to be difficult and this in itself constrained the research effort in various ways. Senior managers are, of course, notoriously difficult people to gain access to, which is perhaps why relatively few in-depth studies have been undertaken. In a study of company directors by Pahl and Winkler (1974), the authors made the following observations about the access problem:

*"We anticipated a very high rate of refusals in ordinary unsponsored approaches, wasting effort and invalidating the very rigour the formal procedure was designed to achieve. This anticipation proved to be correct. Even with personal introductions, we were refused access to 85% of the more than 130 companies we approached."*

In this study, most access attempts were sponsored to some degree and the refusal rate was not that high; nevertheless, access difficulties had an effect on the considerations of the study design and especially validity, so a discussion of the implications was essential. The problem was that if a very high rate of access refusal was experienced then inevitably the question of bias could be raised (to say nothing of the practical difficulties engendered by the excessive time and financial costs involved). Alternatively, if the line of least resistance were taken towards acquiring willing participants, then a charge of 'convenience' sampling could be levelled which would imply, at the very least, that the sample was simply not a sample of anything in particular. These problems were at least partially resolved by gaining access to companies where possible, and then by interviewing three senior managers within the target organisation to ensure observation and compliance with the group triangulation methodology.

In general, although there are substantial amounts of literature on all aspects of the research methodology, there is unfortunately very little discussion of the practical (but essential) steps involved in gaining access to difficult respondents. In addition, most research reports simply do not discuss how access was gained, or mention it only cursorily.

It was found in practice that success in gaining company access was critically dependent on the method employed. This was discovered after some expensive practical experience during the piloting stage. For example, an attempt to gain access to the board of a company from introductions at middle management level proved to be an immensely time-wasting failure. Each attempt to move up a rung of the management ladder was met with delays and difficulties of various kinds, so that although useful background information had been acquired, the researcher was still several rungs below the top even after months of negotiation. In the end, board level access was eventually gained by an indirect personal introduction using a facilitator from outside the organisation (so that all the intervening management levels were bypassed). A facilitator, in this context, is a person who is known to the researcher, who personally knows the target respondent(s) and has the necessary standing to arrange contact. Having gained an appointment to see one senior manager, it was then usually slightly easier to arrange to see his colleagues using his name as a reference. Although some stress has been placed on the method of access as the first factor in gaining entry, it did seem as if some companies had a culture which favoured contact with 'outsiders' (and academic enquiry) whilst others did not.

With hindsight, there are several very good reasons why the 'bottom up' access path should be difficult: top managers regard their time as a very precious commodity, a view shared by their subordinates who depend on access to the top for their success; additionally, there will be political and social reasons which make upwards introductions difficult. However, even direct approaches can have their problems. On one occasion, the chairman of a large organisation had agreed to be seen; but on contacting his secretary for an appointment the researcher was told:

*"Yes, he has agreed to see you, but looking at his diary, this year is out of the question and next year looks very difficult."*

In order to overcome access and selection difficulties and to attain as balanced and bias-free a sample as possible, a strategy was developed whereby many organisations were approached at the top level using an external facilitator where necessary. Having interviewed one informant, a vigorous attempt was made to see other senior managers in that organisation on the same day, even though this move was not always welcomed, either by the main contact or by the informant themselves. The procedure primarily consisted of a carefully worded introductory letter or e-mail mentioning a contact if possible, followed a few days later by a phone call to the manager's secretary. It was generally not sufficient simply to ask to see

people; it was necessary to gain the confidence and interest of personnel at various levels. In practice, most informants required at least one letter and several phone calls to arrange an appointment. On occasions it was not possible to interview more than one informant from an organisation on one day, so in general, the accessing and interviewing process was extremely expensive, both in terms of time and cost. Interviews were always followed by a personalised follow-up letter thanking the informant for their time.

In actively pursuing informants in target companies, a balance had to be struck between being persistent enough to gain access to the desired managers, and yet not so assertive as to run the risk of causing annoyance or damaging the efforts of other researchers. Naturally, there were refusals of various kinds; but in the following eleven companies a board director, senior manager and the IT manager were eventually interviewed, giving eleven (case studies) with group triangulations (33 interviews) where interview selection was considered bias free. These eleven companies formed the foundations of the study transcript database and analysis.

BAe Systems	Mechtool	Moducel
Peter Brotherhood	Rotork	BEL Valves
Cummins	Darchem	Rolls Royce
Siemens	Weir Valves	

To protect confidentiality of the companies and the informants each company has been lettered A to L and the informants numbered 1 to 3 e.g. the Director of company B is B1; the Operations Manager B2 and the IT Manager B3.

In some other organisations, investigations were curtailed owing to denied access to certain managers, as they did not comply with group triangulation. This resulted in individual interviews from informants which, while interesting in their own right and valuable in general analysis, did not have quite the same usefulness as the triangulated results and as such were discounted.

As discussed earlier, the research methodology adopted for phase 1 of the research (case studies) does not need to represent the population of ETO companies in the UK as required in a statistical analysis. It was decided to stop after completing eleven companies for the following two reasons. First, the number and types of companies that participated represented a large variety of ETO in terms of size, technical expertise and supply chain position. Second, it became evident during the data collection and analysis that no new information was emerging and it was decided enough data had been collected to meet the research objectives

(Strauss, 1987). The company which volunteered and agreed to participate in phase 2 of the research (In-depth case study) to check the findings of phase 1 was company B. There were no problems with access to data or attendance at meetings and the whole atmosphere was one of co-operation and interest.

#### 4.8 Data Documentation and Analysis

Phase 1 Research: The interviews were transcribed, and downloaded to Atlas.ti software to create a single hermeneutic unit. Within the hermeneutic unit, sections of text, were coded and linked to quotations to support the observations. The analysis focussed on a cross-case study to identify commonality of managerial problems between the companies from observations taken from the transcripts. Valuable insights came from the qualitative analysis of the transcripts from the open-ended questions. Each interview was analysed for comparisons between the key factors identified as responsible for the slow adoption of B2B practices. There were three transcripts for each participating company. The transcripts were coded individually and linked in groups at various stages of the analysis as the researcher sought categories of factors and other patterns in the data. The data was analysed into conceptual categories against the key factors and supported by direct quotations from the interview transcripts.

The preceding has indicated that the researcher was conscious of (and made stringent attempts to overcome) various kinds of bias arising from the circumstances of the researcher as well as those arising from the circumstances of the research and the different perspectives of the managers. Issues of validity and reliability in this context are dealt with in some detail by Miles and Hubermann (1984) and their treatment has been used as a guide here.

*“When we come up with a finding in a field study, we quickly assume it to be typical, representative, an instance of a general phenomenon. But is it? And if it is, how representative?”* (Miles and Huberman, 1984)

The efforts made here to substantiate the validity of the investigation can be validated in the following three headings:

*Majority sampling:* The researcher ensured three interviews were completed in each company (whether the respondents or organisations were pleased about the prospect or not). This was considered vital because it elicited views from managers who described and responded to their own experience with B2B. In general, the method probed views and experiences which are not usually reported in academic literature, which forced the researcher to take an overall



view. Where the researcher could not see the majority of top managers, then the information from respondents was not included in the qualitative analysis.

*Comparisons and cross-checks:* The information from informants in the participating companies was subject to cross-checks of several kinds. Wherever possible, issues were checked with the informant's peers, with his subordinates, and with his system providers or intermediary. As the research proceeded, the researcher gathered experience from the range of participating companies with which to compare and test emerging issues. In particular, there was the contrast of company ownership on new ICT investments and the position within supply chains.

*A sceptical approach:* Interview questions were included which explored explicit aspects of the managers' knowledge of B2B enterprise integration, and efforts were made to check responses from different perspectives. Wherever possible, statements from one manager's perspective were checked against another's in the same company. The researcher tested his own opinions, concepts and ideas by describing them to the informants when considered appropriate (sometimes to meet scepticism in return!).

Finally, the researcher's qualitative analysis of information from the participating companies' transcripts was subjected to critical review by colleagues and supervisors, who offered valuable comments and insights on the validity of the data.

Phase 2 Research: Case Study: Data was collected as a result of the company owner providing the researcher with access and participation in board meetings, senior management meetings, management reviews and full access to the functional department's managers. The data collected and used covered minutes of meetings, one-to-one discussions, participation in action teams and review of key performance indicators. This case study followed the principles for participatory action research suggested by Denzin and Lincoln (2000). The data was cross-checked to the eleven company transcripts from phase 1 research. It was used to validate the de-coupled B2B integration system and refine the proposed implementation model derived from the phase 1 research.

#### 4.9 Summary

Several alternative research strategies and their associated methodological characteristics have been discussed in the context of the researcher's aims. A research strategy was adopted which involved enacting a programme of interviews with informants from several organisations

in order to generate comparative materials. A key feature of the method was the group triangulation of top managers from eleven participating companies' organisations, which yielded the data from which the findings are derived. Following the interview programme and data analysis a case study was carried out at one of the participating companies to observe implementation of B2B enterprise integration over a full year budget cycle. The aim has not been to describe some 'perfect' methodology, but rather to design the research appropriate to the level of organisational enquiry (e.g. executives/senior managers) and ensure the problems encountered, particularly those resulting from difficulties in gaining company access and issues of reliability, have been recognised and successfully addressed.

## CHAPTER 5 – PHASE 1 RESEARCH STUDY ANALYSIS AND DISCUSSION

As discussed in the previous chapter, the interview transcripts were imported into Atlas.ti software to create a single hermeneutic unit for qualitative analysis. The group triangulation methodology was carried through linking transcript statements having the same outcome against each of the key factors emerging from the theory development by using codes and supportive quotations. This ensured that only consensus statements were used within and across the participating companies, thus mitigating any bias. The following sections present the findings and discuss these statements in the context of the key factors identified from the theory development. Four key inhibitors to the adoption of B2B enterprise integration emerged from the research. These are executive knowledge and awareness, business risk, information security risk and lack of relevant skills. These are discussed as follows:

### 5.1 Executive Knowledge and Awareness

The first part of the interviews was aimed at establishing each participant's perception of B2B enterprise integration. This covered issues associated with knowledge and awareness of the potential risks to the business during implementation. The companies interviewed provided evidence of process integration within their operations. However, in terms of knowledge and awareness all informants could not clearly define B2B enterprise integration within the context of their operations, as shown by the following quote by the Operations Manager of company D:

*"I'm assuming this is an IT thing, so in which case it's about, in its pure sense I guess it's about the transmission of information electronically whether it be technical or commercial, probably there's some sort of e-commerce activity in there as well."*

This demonstrates a lack of detailed knowledge at senior management level within the participating companies. In addition, it confirms the findings of previous research carried out by Froome (2000), where it was claimed executives lacked knowledge of B2B enterprise integration. Of those directors interviewed only two had PCs on their desks. These two directors demonstrated their knowledge and awareness of the benefits B2B could provide but could not offer a definition of this concept. The other directors relied upon their secretariat to receive e-mails, attachments and other electronic data. The secretariat printed these for the directors to read and dictate a response, which was subsequently sent by the secretariat. This is considered to be a complete waste of time and defeats the object of an online integrated e-mail system. It can be compared to Hamel (2001), where he suggests computer technology is

so far advanced it is the limits of human imagination which prevents progress. The Director of company A, who used a PC , offered the following definition:

*“I would define it as having systems that allow us to interact with other businesses or our customers, partners, electronically, electronic links between their systems and our systems, for instance for ordering, invoicing rather than the old paper based ways of doing things.”*

This quote references ordering and invoicing but fails to capture the seamless electronic integration of the entire business process which characterises B2B enterprise integration. At business unit and IT manager levels all were competent users and discussed integration of business systems at various stages of knowledge development. This will be covered in more detail in the next section. One elderly Business Manager of iconic status in company L complained about the number of e-mails he received but thought the advances in communication technology were “terrific”. He stated:

*“A simple analogy for me being a boring old grey hair is that when I was sat on an aircraft, heading for France, not more than 3 weeks ago and hit the hotel on the evening I realised I was actually sorting some of the correspondence, not by the date, but by the time of the day it was sent because in any one given day you might have 3, 4, 5 exchanges in correspondence on the same subject, and you have got to date and time wise sort them or you lose the routine of what answers mean what. It’s absolutely astonishing. So it’s made an incredible difference from the luxury of 30 years ago where you used to post a letter, thankfully if it went to Germany it took 5 days and you got 5 days of peace. Then they invented the telex to the fax and that was really a mind blower and from the fax we have got this thing that you put on your desk and all of a sudden you are getting information in your face, so I think that’s been terrific.”*

The traffic of e-mail exchanges in all the participating companies was considered a significant problem. This created contractual issues with tracking correspondence, particularly with disputes. As stated in the above quote e-mails are recorded by the minute and second they arrive. This can lead to external and internal conflicts arising over disputes/misunderstandings which could be resolved by a face-to-face discussion. However, if you are operating on global networks it is not always possible to meet up, other than by video conferencing. The following quote from the Operations Manager of company J shows awareness of this problem:

*“The e-mail system is frightening in today’s world. You can get this aggravated level that rapidly develops and escalates without any real cause. When you look at B2B because B2B are just people themselves dealing with their day-to-day business and taking a customer upstream and a customer downstream. I often feel that we have lost the touch and we have lost the personal touch in that.”*

It can be argued that there is a general awareness of B2B enterprise integration amongst senior management teams, particularly the effect of e-mail traffic on contractual issues and inter/intra company disputes, which can escalate unnecessarily. In addition, there is a general awareness of the business benefits of electronic purchase ordering and invoicing. However, there is a lack of knowledge at board level regarding B2B enterprise integration and its benefit to improving business performance by electronically integrating process systems within the company and externally with customers and suppliers. Business and IT managers were found to be frustrated at the slow progress made by their companies in the adoption of B2B practices and boardroom policy diktats as the Business Manager of company L stated:

*“I know I have got 24 computers that are the best thing since sliced bread in the cupboard, but the fact is you can’t have one today, and yes, I know you have got PowerPoint 1964 and it has gone to 2005 but you’re not up to the level to get it. If we haven’t got the best equipment then we are going to be left behind in the pressures of today so my answer would be, I am disappointed at board level in the IT understanding and the IT department service.”*

Although this manager is criticising the IT department they are only acting out the policy set at boardroom level. However, it does demonstrate how conflicts are manifested and how emotions lead to perceived views on a department putting barriers in the way of progress. In terms of the awareness, all of the directors interviewed admitted they did not know enough about the concept to embark on the investment but recognised the business benefits, as was articulated by the director of company E:

*“I know the general benefits of using these systems. However, I need to know what they mean for us. By the very nature of our operation (...) we have challenges which suggest we cannot simply implement off-the-shelf solutions. So we need to know how these general benefits of information sharing will apply in our case. A technical brochure is not enough to convince me (...).”*

It is important to recognise that despite the scepticism expressed; most of the informants understood the benefits that B2B enterprise integration has brought to other industrial sectors. The concerns were related to a lack of awareness of the application to the ETO sector and more specifically to their business and it was this that created the greater doubts. This confirms that senior management awareness is a key inhibitor to the adoption of B2B enterprise integration. It can be related directly to the TAM2 literature covering perceived usefulness (Venkatesh and Davis 2000) where the decision makers lacked knowledge on the perceived usefulness of B2B systems for their companies.

## 5.2 Business Risk: Strategy, Payback and Continuity

### Strategy:

Each of the participating companies held annual strategic reviews which were represented by a cross-section of functional disciplines and chaired by a board director responsible for IT. Invariably, the board director either had an interest in IT or was a chief executive's reluctant nominee. These committees relied upon the business managers to set the strategy and the IT managers to provide insights into the new available technology to enable the strategy, which was subsequently approved by the board. This quote by the Operations Manager of company C confirms this process and also comments upon the problems if the strategy is determined by the IT specialist:

*"My genuine belief is that the business sets the strategy and IT enables it and when you have got that the other way round that is when you have got an IT function which is extremely poorly perceived by the business."*

The following quote by the IT manager of company B confirms the findings in Chapter 5.1 that directors lack knowledge of B2B systems and have to rely upon specialists to provide a solution:

*"It starts at a director level but then they say right, well we are not clever enough to sort it out, they don't say that, but it's the reality, they know there's a problem. So they then call in a specialist like me to say right, this is what we would like to do, how can we achieve it?"*

This particular IT manager was challenged during the interview to demonstrate his involvement in the setting of IT strategy. His business manager and director both stated it was

achieved by committee consensus. He agreed to this and confirmed his role was to enable the strategy by recommending and introducing the appropriate IT systems.

Concern was expressed at the rate of change in the availability of improved IT business systems offering full integration. Examples of these are SAP, Oracle and Epicor. This confirms the work carried out by Soliman (2001), Mezianne (2000), Hendy (1999), Nah et al. (2001), Kumar (2003), Peppard et al. (2007) and Harland et al. (2007) concerning critical success factors for implementing these types of business systems. Directors expressed the view that these types of systems are sold to them on the basis of achieving a level of return on investment by a reduction in operating costs. However, in reality these savings don't materialise and in fact required an increase in the level of skills required to operate them. The business managers complained about the limited level of integration achieved and the contamination of databases caused by legacy systems. IT managers blamed the board of directors and business managers for not defining an appropriate strategy or allocating a sufficient budget. This quote by the operations manager of company F is a typical response to these issues:

*“Technology is just moving on and on so quickly. I think that's a problem because there's always this trade off issue that says; right we have got this new system that's going to do this for us. Then you say yes, but will that sort do the system and does that mean because we have upgraded this system we've now got to upgrade this other system? Can we afford to do it? Have we got the time to do it? Have we got the resources to do it? What are the risks? I might go to a conference one day and see a brilliant supply chain tool that I want to bring back and integrate in some way, but it's not just about supply chains it's about all the other disciplines. Because all the systems are supposed to talk to each other but they don't seem to without a glitch or some other bug.”*

Another important issue in setting strategy relates to the business demand cycle. By definition, ETO companies are project-based and therefore cyclical in demand. Therefore, ETO companies' integrated business systems require a degree of agility to respond efficiently to the cyclic demand, as defined in the literature review in Chapter 2. The problem for ETO companies lies in synchronising the supply chain throughout the entire business process, both internal and external. This quote by a Director of company H, a company that has implemented a SAP system, describes the problem they encountered:

*“We have a lot of non-integrated systems currently for managing forecasting, and the reason we do that is because our business is quite cyclical, and we need to be able to react to the business cycles and this can happen in a busy period or a quiet period. You get spikes and troughs, and the first thing that hits when an order comes in is you have to engineer it. So although, yes we’re going to have to find the machine capacity for something, we actually have from booking an order, we have three to four months to find the machine capacity, where we design it and procure the materials, but the thing we don’t have any time to find is the engineering capacity. So we have to be able to shrink and grow engineering capacity effectively. So we spend a lot of time on the front end, mapping what could come in. All of the estimating that we do is because we estimate bespoke products, everything’s different.”*

On the basis of the above discussion, it is apparent that ETO companies are experiencing significant problems when integrating sophisticated ERP systems with bespoke computer programs. These bespoke programs provide ETO companies with their added value and competitive advantages. Therefore, there is an argument from a strategic standpoint as to the appropriateness of integrating these systems. For example, seamless integration between customer and supplier could lead to a loss of competitive advantage or access to sensitive IPR. A possible solution to this important managerial problem could be the adoption of decoupling between sensitive and non-sensitive data within integrated systems.

The informants expressed concern at the level of synchronous supply chain integration, as proposed by Christopher (1998), Tan (2001), Lockstrom et al. (2009) and Flynn et al. (2010). Attempts had been made by two of the companies to fully integrate suppliers. However, they found suppliers demanded security of supply and long-term agreements. In addition, suppliers could not afford to integrate and operate the same sophisticated ERP systems as their customers. The participating companies encouraged competition between suppliers and this was viewed as being adversarial in the context of synchronous supply chains. In the context of customer supply chain integration, significant resistance was observed, as is confirmed by the Operations Manager of company E in this quote:

*“I think on the customer side we try to avoid supply chain integration. Although we use a lot of IT, it’s support systems for our sales. We have people around the world whom are tracking projects, keeping them informed, we like to limit that to our own people. So we don’t rely on integrated systems with customers, in fact we try to avoid it.”*



The interviews highlighted two approaches used by ETOs for synchronous supply chain integration. These are seamless integration for commodity type products and de-coupled integration for customised configured products. Linkages of statements from the interview transcripts have been tabulated as follows:

Commodity Products

Customised Configured Products

Lowest cost wins	Value added wins
Highly competitive markets	Niche markets
Low margins/high volumes	High margins/low volumes
Low added value	Value added
Ideal for buyers	Not ideal for buyers
Lean thinking a prerequisite	Create monopolies/oligopolies
High turnover of suppliers	Funding for product development
Lack of investment	Investment/marketing manipulation
Attraction of low cost economies	Patents/security of IPR
Turbulent business/less control	Creating/innovation
Sustainable business/control	

The above can be linked into reality trees constructed using Goldratt's (1999) theory of constraints where the arrows flow in a logical sequence of "if"; "then" (cause and effect links). This attempt's to explain and understand the negative approach to synchronous supply chains by ETO companies. These reality trees demonstrate the avoidance of commoditised products by ETO companies.

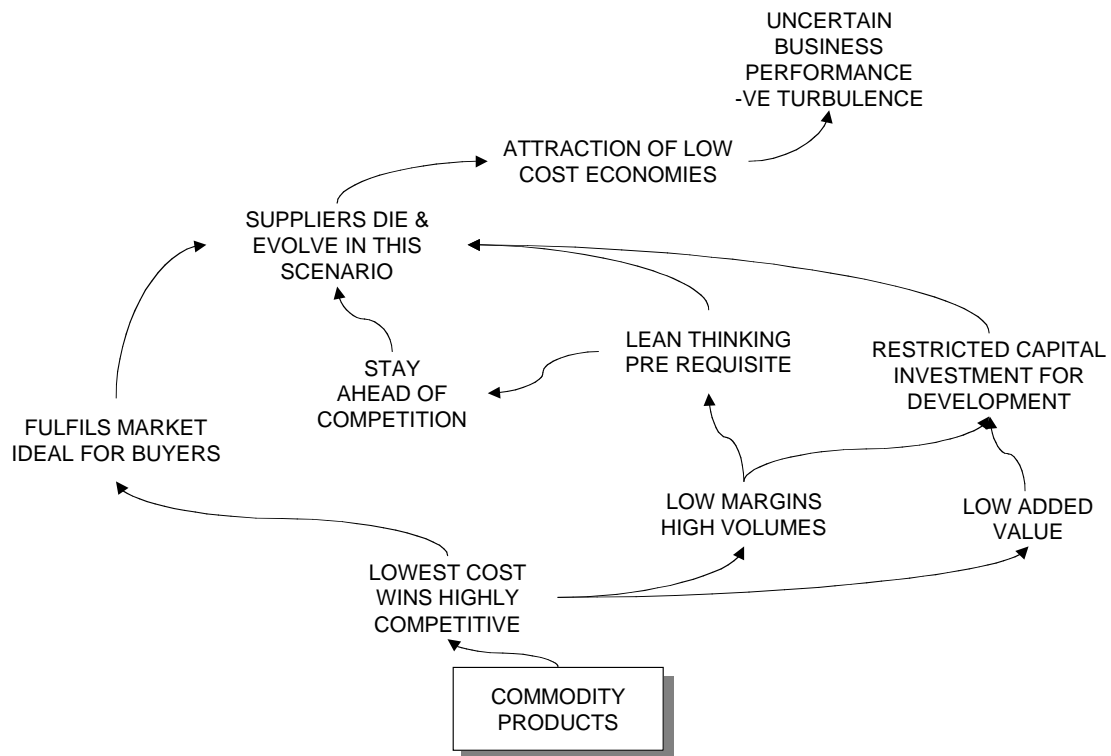


Figure 12. B2B Seamless Integration Reality Tree

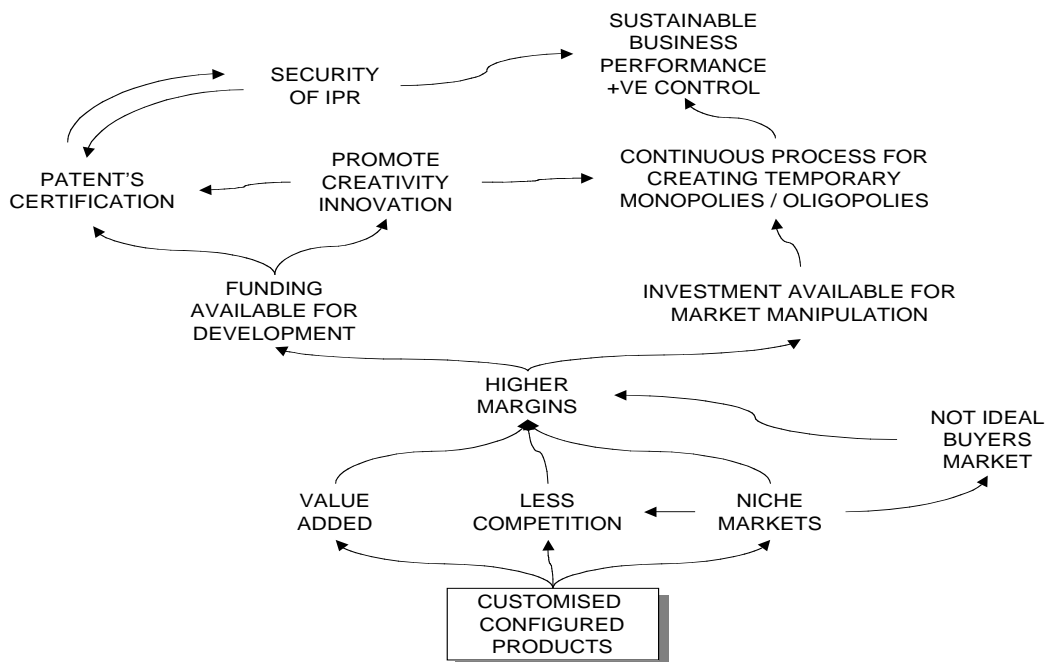


Figure 13. B2B De-coupled Integration Reality Tree

The reality trees confirm that ETO companies strive to continue operating in niche markets by customising or configuring their products. They oppose commoditising products and becoming involved in synchronous supply chains. Their preference is to be de-coupled at the customer integration interface, thereby protecting competitive advantage and IPR.

Another important element that affected the informants' perception of B2B integration in the context of supply chains was the increasing pressure by key customers to sell via e-auctions, i.e. an inter-organisational information system that allows sellers to compare bids from multiple buyers (Choudhury et al., 1998). E-auction collaboration continues to be driven down supply chains, not only for commodity items, but also for major equipment including project work. All informants expressed their concerns regarding integration with suppliers and customers in this regard. The following quote by the Director of company A confirms the concerns:

*"There isn't a saving in the e-auctions because there could be six companies having to refine bids down to the final order stage. Ordinarily, the customer would say, well OK there's six bids out there and there's two lots, let's develop two, but now they are saying let's develop all six. Then you get to this final auction where the dynamics are still very questionable."*

The informants also argued that there is excessive and adversarial pressure on price reduction as a direct result of e-auctions. Particular reference was made to the role of the intermediary organising the e-auctions. The informants' perception is that buyers are paying for an intermediary to obtain the lowest price from the supply chain base. This results in reducing the available revenue to the supply chain base and passing it to the intermediaries. This quote by a Director of company L reflects their concerns:

*"We know that we're ultimately getting paid on added value and some of our clients might put a different weighting on the service that we offer and all of that has gone out of the window with auctions it has gone to the host."*

From the interviews, it is apparent that customers are driving e-auctions throughout the supply chains. This is verified by the findings published in the CBI (2005) publication *e-value matters*. With regards to ETO companies, the benefits of e-auctions from a supplier perspective are not viewed positively. It can be argued that ETO companies have a deliberate policy of either avoiding e-auctions outright or participating on the basis that their bid is technically superior in

terms of quality, delivery and specification interpretation. The following quote from the Director of company B summarises a supplier's perspective:

*"I don't believe e-auctions have meant a lot. I think for our customers they've been testing the market but they have been a little bit mischievous in involving different parties who are at different stages. So the price really doesn't reflect the same quality basis, but we have effectively maintained our non-e-based bid and we bid it at customers' requests at an auction. There have been very low prices introduced and we believe they are from third world countries, although manufacturing countries, but at the end of the day we still won the business at our higher price because we can generate the quality and delivery requirements. A lot of customers use the pressure auctions to see if they could get reduced prices by us seeing lower numbers. I think at this stage you have to hold your cool, and e-auctions are not yet I believe in our business a level playing field. There is too much confusion on quality and other hidden items within the spec that make up supply selection."*

The use of e-auctions within synchronised supply chains is considered a fundamental part of a commodity product market. However, within the ETO industry sector, e-auctions are not considered to be a prerequisite of supply chain integration and on the basis of this study are not considered appropriate. B2B enterprise integration does not rely upon e-auctions. Therefore, the rejection of ETO compared to e-auctions is not considered an inhibitor to the adoption of B2B practices.

Performance:

With regards to measuring improved performance from B2B enterprise integration all companies had not established metrics. The Director of company E expressed his concerns at using return on investment as a means for assessing the benefit of information technology systems. Despite the lack of metrics, however, most organisations recognised that the adoption of B2B practices to a certain degree is the prerequisite for a business' operation in today's environment:

*"We don't measure it. On a high level we will be measuring profitability of the business because it is very much part of our owners' demands. The business has measures, goals, targets and aspirations through all the key process areas but*

*these do not relate directly to performance improvement as a direct result of investment in B2B.”*

In order for B2B enterprise integration to perform effectively, it requires the efficient use of PCs by employees, which in turn requires positive support from IT departments. The measure of this efficiency and support was considered intangible. However, informants were aware of the need to use the technology effectively, as is confirmed by this quote from the IT manager of company A:

*“Adding value through IT support other than connectivity is about efficient use of the PC. At the end of the day the PC is a tool, it’s just a tool to help within the business. We have got to ensure that people use that tool as effectively as they can to help drive the business. To help them do what they need to do for the business, but that tends to be more or a, we wish we could get to that point, but I think that is a very important point that we would make sure that people use the technology effectively.”*

In addition, there was overall consensus that ETO companies cannot survive in a global market without the use of computers and elements of B2B enterprise integration. Therefore it is a fundamental business need as opposed to an added value financed measure. The following quote from the Director of company E reflects this view:

*“I think the reality is, without computers, without the ability to talk to people around the world, through computers, we wouldn’t be in business. So I think it’s more a case of you have got to have state-of-the-art or as near as you can afford state-of-the-art computer equipment in order to have your best tools available. I would find it very difficult to say that this financial year would show financial benefits say, over the last financial year because of the use of computers. I have to say, at the moment I don’t know another way of doing that. I don’t know how you would benchmark yourself year on year. I may be missing something here, I don’t know. I think it is extremely difficult to convincingly model improved performance as a result of IT investment. It’s probably more of a matter of needs must than anything else. I have seen efforts, mainly back door efforts, particularly by consultants, to justify IT investments. I have always thought they were very false or rather hollow.”*

Sales teams were on networks enabling everyone all around the world to have information instantaneously available twenty-four hours a day, seven days a week. Senior managers are

therefore better informed and have the benefit of obtaining key market information as it develops and it can be sent to all those involved instantaneously. Financial improvements as a direct result of B2B are considered intangible. Yet, the informants argued that it enables the sharing of knowledge and data.

All the informants claimed improved operational performance was directly related to the use of computers and process integrations similar to B2B enterprise integration. Examples of perceived improvements were increased throughput per employee, less inventory and lean operations. The following quote from the Operations Manager of company J is a typical response:

*“The operational improvements we don’t tend to measure, how that has benefited the business is sort of fairly intuitive. You have got the upgrade to keep up to date and stay competitive. So those things we don’t measure, but there have been significant improvements like less inventory and we do more. They are probably the most noticeable improvements in the recent past. If the systems weren’t in place we would be in trouble. You just couldn’t handle the amount of work that is now going through the place without the systems, a) to assist you doing the work and b) to control it.”*

In order to explore whether the claims of increased throughput per employee, reduced inventory and lean operations are factual, the financial accounts for the participating companies were obtained throughout the period of this research. Two of the companies’ accounts were distorted due to acquisitions/divestments and are therefore not included. On the basis of the interviewees’ claims, the following macro measures should be valid:

- (i) The sales volume per employee should increase year on year.
- (ii) The work in progress as a percentage of turnover should decrease year on year.
- (iii) The working capital as a percentage of turnover should decrease year on year.

These were checked by contacting the financial directors of the participating companies and they confirmed these were measures they would use as generalised indicators. However, they confirmed that other factors would need to be considered in any analysis, such as acquisitions/divestments/new product development. The consensus was that it is extremely difficult to assess any payback from investment in IT systems. For the purposes of establishing an indication of the payback, the three measures for each company covering the four years of research, e.g. 2007, 2008, 2009 and 2010, were reviewed. Only two companies indicate a

year on year improvement in accordance with the above three hypotheses. It should be observed that this is not a statistical analysis. Furthermore, any improvement cannot be deemed directly attributable to the adoption of B2B enterprise integration. However, it does provide an indication and could be developed further as potential performance measures. As discussed in the previous chapter, a statistical analysis is outside the scope of this study but could be pursued in future research, including a set of appropriate performance matrices.

#### Business Continuity:

All the interviewed companies were found to have disaster recovery plans, which ranged from taking copies of hard discs each day to backing up servers in separate buildings. On this basis and given sufficient time to either load up or switch to alternative servers each company should be able to operate the business systems adequately in the event of a complete crash, as may be seen from the following quote by the IT Manager of company B:

*"I would have to say that if there was a complete crash, it would be a significant event and it would cause quite a bit of disruption, but it wouldn't be fatal, the business would survive, it wouldn't go down. We have back up systems internally. We used to get power surges that caused problems, so now we introduced through technology something so that doesn't affect us."*

The above demonstrates that companies can be back up and running their computer systems within a given timescale. However, during the down time only one company was considering implementing a business continuity programme to ensure employees could perform their roles and add value to the operation. As described in the following quote by the IT manager of company F, it is essential for companies to evaluate the time lapse from incident to when a business continuity programme should start.

*"If you think the system is going to be down for five plus hours then you should start to introduce something. We are so systemised now that actually doing things manually causes you more problems in terms of catch up than it does in just not working for five hours. We are introducing a business continuity approach, function by function, what can we do, what can't we do, what do we need to do to make sure we have always got enough staff with a certain skill level to keep going. Some basic things and some quite complex things. If that system goes down can you process manually, can you catch up, those sorts of things. As I say, we have disaster recovery, we don't have business continuity plans."*

None of the informants discussed incubation of latent defects in the context of system failure, as identified by Turner (1976), Reason (1990, 1998) and Smith (2000) despite several prompts by the researcher. This demonstrated a lack of knowledge within the companies of the consequences of a situation whereby a rare occurrence of a combination of system failures, whether human, organisational or technological, have disastrous outcomes. These can be catastrophic, as in Bhopal, Challenger Space Shuttle and Herald of Free Enterprise, to name but a few. If this sample of ETO companies is typical in this regard it is of concern to the industry and requires attention. As suggested by Smith (2000), organisations are becoming more virtual due to B2B enterprise integration. Therefore, their tangible assets become increasingly critical and Turner's (1976) incubation elements have a greater relevance. It is essential that ETO organisations raise the profile of crisis management and business continuity in the context of incubation of latent defects through a learning process, as proposed by Smith (2000).

To summarise, the participating ETO companies express concerns about the application of B2B enterprise integration to their sector and their companies which leads them to deploy strategies to protect their position Stacey (1992). They do not directly measure the performance improvements due to implementation of B2B enterprise integration and they have concerns about business continuity during implementation. This has led them to adopt appropriate business continuity planning. Overall, this can be considered as a managerial problem to overcome due to business risk.

### 5.3 Security Issues

Each of the companies participating in the research held a market niche through their specialist products and services. The knowledge to develop their products was created through an incremental process that may have taken years and often decades to complete. Bespoke computer programs for product designs are an example of this. Such knowledge is protected by patents and shrouded in secrecy. Patenting new processes offers some protection but due to the high depreciation of the patented knowledge, as suggested by Schankerman (1998), and difficulties in patenting new complex technologies, as highlighted by Kingston (2001), secrecy is considered a more desirable option by the ETO sector. As a result, ETO companies' information systems often store sensitive data, which if accessed by their competition could have a significant impact on their continued competitive advantage. Fear of such a breach thus acts as a major problem to the adoption of B2B enterprise integration. As previously described, this is generally related to the protection of IPR,



certification and the protection of bespoke engineering design programmes. As explained by the informants, this is because ETO companies customise their products to the specification of their customers. It is the IPR, certification and bespoke programmes which provide effective barriers to market entry for their competition. All the participating companies had appropriate firewalls to protect their business systems from external threats. Yet, there was a definite concern with regards to the protection of IPR. The importance of appropriate security measures cannot be overestimated, as indicated by the following quote from the Director of company L:

*“IPR is the most important thing the business has got and it is incredibly difficult because even when your bidding works, you are talking to customers, there is a certain amount of information that you have to divulge to explain what makes you different from the competition, so there is a worry, and we have seen examples in the past where perhaps that we have been taken advantage of in terms of quotations and work on proposals has not come our way and perhaps had helped one of our competitors along the way inadvertently.”*

The use of confidentiality agreements or contractual terms were both referenced as measures companies were taking to protect data on, for example, new products which could reside on websites or intranets which could be accessed by customers. Whilst this can provide a degree of confidence towards a customer supplier interface, it does not prevent violation of patents, IPR, trademarks and copyright by fraudsters and unscrupulous competitors, as confirmed by the work of Attaran (2001), Morris et al. (2000), Papadaki and Furnell (2006) and Jeong (2011). The sensitivity of data and customer access with confidentiality agreements is described in the following quote by the Business Manager of company H:

*“We are becoming very sensitive to data, particularly when it comes to new products. We have got a lot of information on websites specifically designed for that and you know we have Internets and Intranets and all that good stuff. There is a lot of concern about the information we put in there and we tend to be very conservative about what information we put into the public domain and how we secure that to ensure only the appropriate eyes can see it. I know there is a lot of data out there on our Intranets that we give access to certain customers providing they sign confidentiality agreements.”*

Companies are experiencing increased levels of attacks from sophisticated viruses and hackers. An average incident could cost in the order of £400,000 according to the DTI's 2008

Information Security Breaches Survey. As malicious technologies become more profile, diverse and targeted, it is important for the ETO industry sector to know how to perceive and react to them to protect supply chains and have effective contingency plans. This quote from the Director of company L captures the essence of this problem:

*"I think the whole system has to be cloaked with a very high level of security, and it is to our credit that ours certainly is. No major virus attacks have got through because we have spent significant monies on firewalls, checking those firewalls and changing to the very best virus protections. 3,000 viruses per month attack the company. We just have to be very vigilant because things happen to servers, they get hiccups, sometimes we get to read upload viruses but again people are aware of what they should be looking for and if they are in any doubt they phone our IT Department. A couple of times some viruses have got on individual sheets but vigilance of the user level connected to the system in IT has solved the problems, but it is something that we will continually learn to live with."*

The growing importance of working outside the company walls via remote access into head office systems presents a new set of potential security violations to be overcome. Access can be gained by a variety of methods such as modem telephone links, mobile phone, infra red, GPS, wireless, iPods, USB memory keys, Blackberries and iPads. The TAM2 models proposed by Venkatesh and Davis (2000) only cover the internal perceived ease of use of these systems and does not cover the social impact/power changes when these systems are used remote to the organisation. ETO companies should use authentication tools such as passwords and certificates to control the flow of information from company systems to mobile devices. All data flowing over the networks must be encrypted. Mobile devices should be protected with power-on passwords, firewalls and anti-virus software all updated regularly. Companies should ensure they have the ability to wipe data from a device should it be lost or stolen. However, these measures only work if employees understand them and follow them. The end user must be fully aware of what he is carrying and what the rules are. The company must take responsibility and provide adequate training/awareness to individuals.

#### 5.4 Human Behaviour: Influences and Consequences

ETO companies' technical knowledge is relatively high. ETO companies' manufacturing and supply chain processes are unique and the level of customisation is very intense. Therefore, a lot of tacit knowledge is accumulated by the workforce and this makes it difficult to replace. Thus, when the need for new skills arises, such as the acquisition of new technology, training

existing staff is the preferred option to recruitment. Consequently, all but one of the companies interviewed had a strategy for re-training existing employees. The following is a quote from the Operations Manager of company K:

*"I think that in all the areas up to now we managed to accommodate the electronic change with the same people. With regards to the Sales Office, there was a guy in there that everyone thought, no way, but off he went, and he got there and he was fine. We haven't released anyone from the business because they haven't got the skills. It may happen, I'm not saying it won't happen, but currently we have not had to let anybody go because they are not capable or un-willing to work with that type of technology, and we hope to be able to bring most of the people with us."*

The informants also confirmed that in the ETO sector, manufacturing and supply chain processes are unique and the level of customisation is high. Hence the need for experienced employees. The type of new employee recruitment was raised as an issue which is similar to Hollinghead et al. (1999). Preference exists for new recruits, particularly white collar functions to have a minimum degree level and be IT literate. For some companies, this has meant recruitment from outside the local region to acquire the appropriate skill levels as stated by the operations manager of company D:

*"We take on a lot of graduates, people with degrees and things like that who are obviously quite IT literate and you see more and more of them coming into the white collar areas now and you have got to manage that appropriately. We have seen the introduction of quite a lot of people from other areas of the country because we recognise we need a different type of person and they are not always readily on hand with IT skills."*

There was no firm evidence to support the view that adopting B2B practices reduces head count as perceived by this quote by the Operations Manager of company G:

*"A lot of companies introduce systems with a view to saving head counts and one of the objectives is to either re-deploy people or make them redundant or retire them without replacing them. One of the objectives is always cost reduction and one of the most obvious areas that they look for cost reduction is reducing head count."*

On the contrary, the consensus was the opposite, as confirmed by this quote by the Operations Manager of company C:

*“None of these systems are put in place to get rid of people. The idea is that we all have plenty to do, so they can be re-deployed on other important issues such as improving the product.”*

The importance of overcoming organisational resistance to change was recognised and considered to be an important factor. It was noted that the organisations researched share the key elements of their organisational culture. Engineers and draughtsmen were quoted as the main culprits to blocking change processes. This can be explained because they are protecting their tacit knowledge and experience, which is similar to a company protecting its IPR. This quote by the Business Manager of company L is a typical example:

*“There was a significant resistance by the Drawing Office, to moving away from the drawing board to sitting at a computer keyboard, and moving a mouse around. It took a little while to overcome their nervousness and their concerns as to whether this was a development that they would embrace with enthusiasm and really get involved in the training. At that time our owners were a little bit old fashioned and very much in the mind of if you don't want to do it we will get somebody else. To me that was wrong because you have got a lot of experience there and what you need to do is harness the experience and develop their skills to be able to use the new technology.”*

The significance of a comprehensive integrated change management and training programme cannot be overemphasised. Hamel (2001) captures this by focusing on the unimaginable speed of the rate of change due to advances in B2B enterprise integration. On this basis fast change is required but the Internet only provides the platform, then the timing and quality of the preparation by the company for the coming impact is vital to the performance of B2B adoption. This quote by the Business Manager of company L realises the importance of training:

*“Training forms a fundamental form of that because you can have the greatest IT B2B in the world, but if you haven't got the troops following along in a knowledgeable manner then you may as well save the money.”*

To summarise, adoption of B2B enterprise integration in the context of human behaviour requires an integrated change management and employee training programme. It needs to recognise the organisational culture, employee age groups, employee job security concerns and selling the perceived ease of use of new technology. Furthermore the perceived benefits and how their jobs can be improved including the opportunity to aspire to new levels of attainment similar to TAM2 proposed by Venkatesh and Davis (2000). Finally, it must recognise that tacit knowledge which provides their competitive advantage is accumulated by employees and is difficult to replace or replicate.

## 5.5 B2B Status of the Participating Companies

Using the diagram presented by Adams (2000), the status of the interviewed organisations relative to other sectors that have implemented e-business integration is shown in Figure 14. Companies are identified A to L and informants numbered A1, A2, A3 for directors, operation managers and information technology managers respectively. The findings generally demonstrate the participating companies to be in a transition between the Web and e-commerce regimes. There is reasonable correlation between those interviewed within a company. Only one IT manager (J3) appeared to be out of synergy with his colleagues.

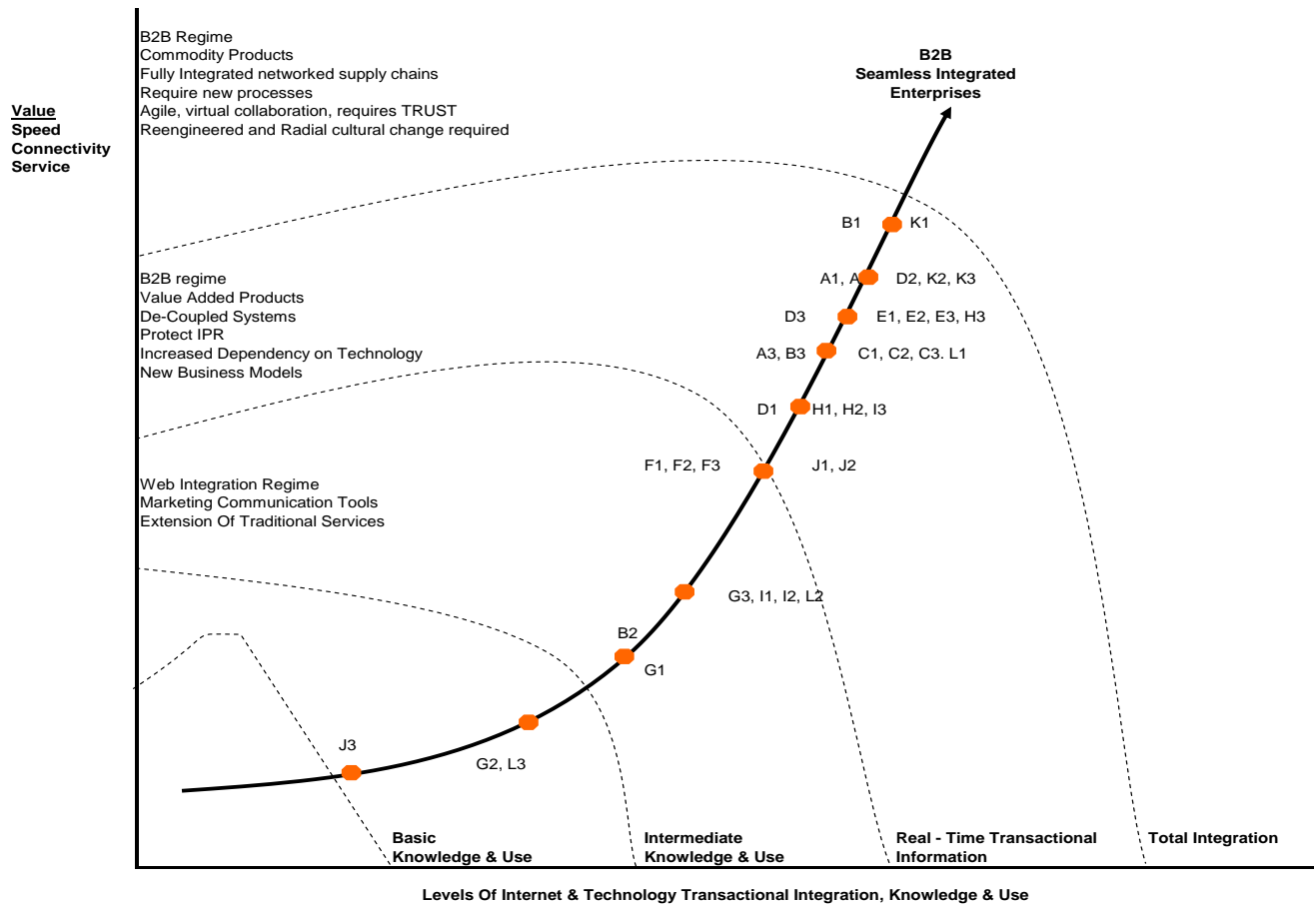


Figure 14. B2B Development Map: Perceived Status of Participating Companies

The findings of the study conclude that these companies are not aspiring to adopting full seamless B2B enterprise integration. On the contrary, there is a deliberate strategy of de-coupling their bespoke knowledge systems to protect competitive advantage and IPR.

## 5.6 B2B De-coupled Integration Hierarchy

From the above phase 1 research discussion it is concluded that ETO companies are reluctant to implement a seamless B2B integration hierarchy from customer to manufacturer and supplier. The discussion found that security of IPR is very important to ETO companies and there is a reluctance to allow both customers and suppliers access into procurement and stores functions. The IPR of ETO companies is held within the bespoke design functions. De-coupling of these functions including procurement and stores can be arranged as shown in the following hierarchy. This hierarchy was shown to the participating companies by re-visiting them after the interviews for their feedback. Overall the informants were in agreement with the de-coupled approach.

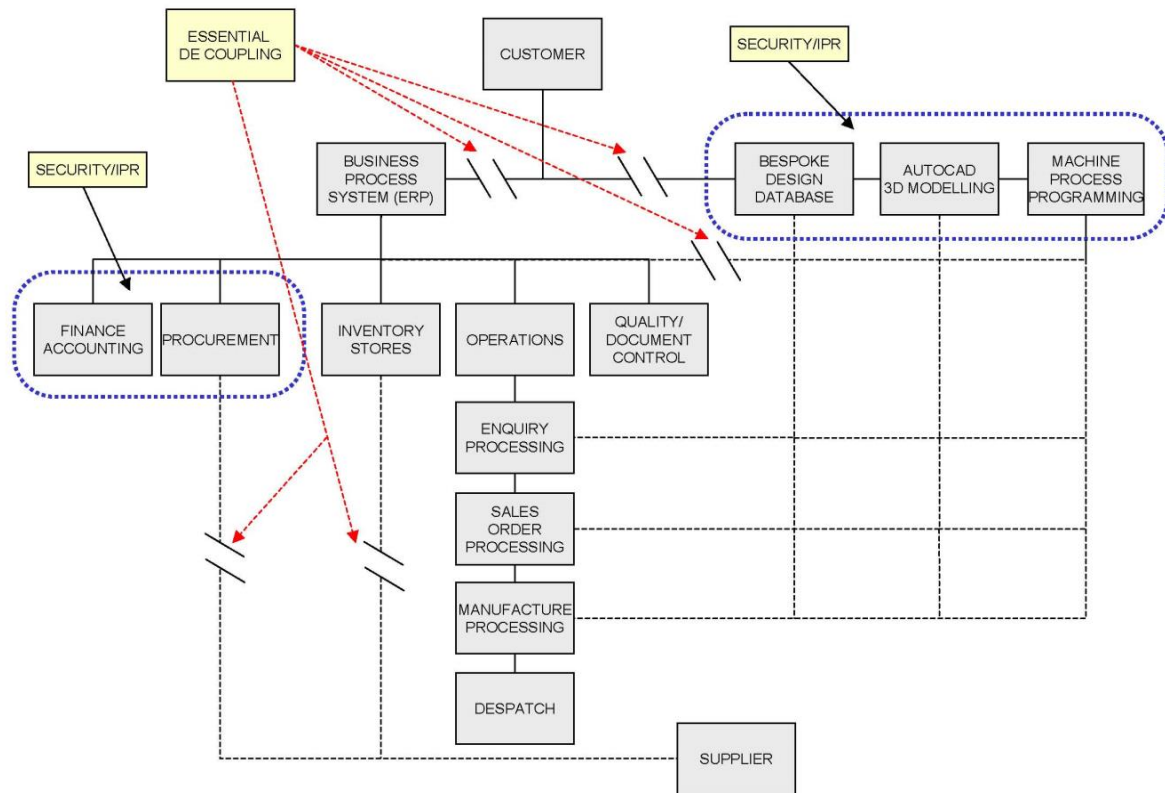


Figure 15. B2B De-coupled Integration Hierarchy for ETO Companies

This B2B de-coupled integration hierarchy addresses the concerns expressed by key informants during phase 1 of the research regarding access to sensitive data by customers and suppliers. However, it does not address the concerns expressed relating to employee skills and business continuity during implementation.

## 5.7 Other Observations and Proposed Implementation Model

During the interview process notes were taken about each companies turnover, number of employees, average age estimation from informants, company age and the types of B2B integration.

<b>Company Identification</b>	<b>Turnover (£millions)</b>	<b>Number of Employees</b>	<b>Average Age Employees(YRS)</b>	<b>Company Age (YRS)</b>
A	55	710	36 to 40	91
B	10	200	46 to 50	43
C	754	5,500	36 to 40	92
D	9,095	69,400	41 to 45	34
E	146	1,140	36 to 40	66
F	5,939	35,200	41 to 45	107
G	37	480	46 to 50	51
H	24	240	41 to 45	171
J	73,275	359,000	36 to 40	165
K	2,292	14,000	41 to 45	140
L	33	620	41 to 45	57

The following was observed:

- Companies > 5,000 employees implemented expensive complex business systems such as SAP and Oracle which cost millions of pounds.
- Companies between 300 and 500 employees implemented mid-range affordable business systems such as Kewill and Epicor, typically costing £500,000.
- Companies < 300 employees used bespoke systems developed in house and were claimed to be highly customised to their business requirements. Relatively cheap (typically £15,000) bolt on software packages were utilised to provide connectivity between separate parts of the business.
- IT Managers at each of the companies were in the 30 to 40 age bracket whereas the other informants were all over 50 years of age.

It was found that larger companies (> 5,000 employees) exerted pressure down the supply chain for compliance with their systems as found by Harland et al. (2007). This caused problems, not only with affordability to adopt the same complex systems such as SAP, but also access to sensitive IPR information. It was apparent from these observations and the key informants' experiences discussed during the interviews that there was no theoretical model or recommended practice used by the companies during the implementation of B2B enterprise integration. Taking these observations and experiences into account, the researcher proposes an implementation model to overcome the four key inhibitors identified to the adoption of B2B enterprise integration in UK ETO companies (refer to Fig 16).



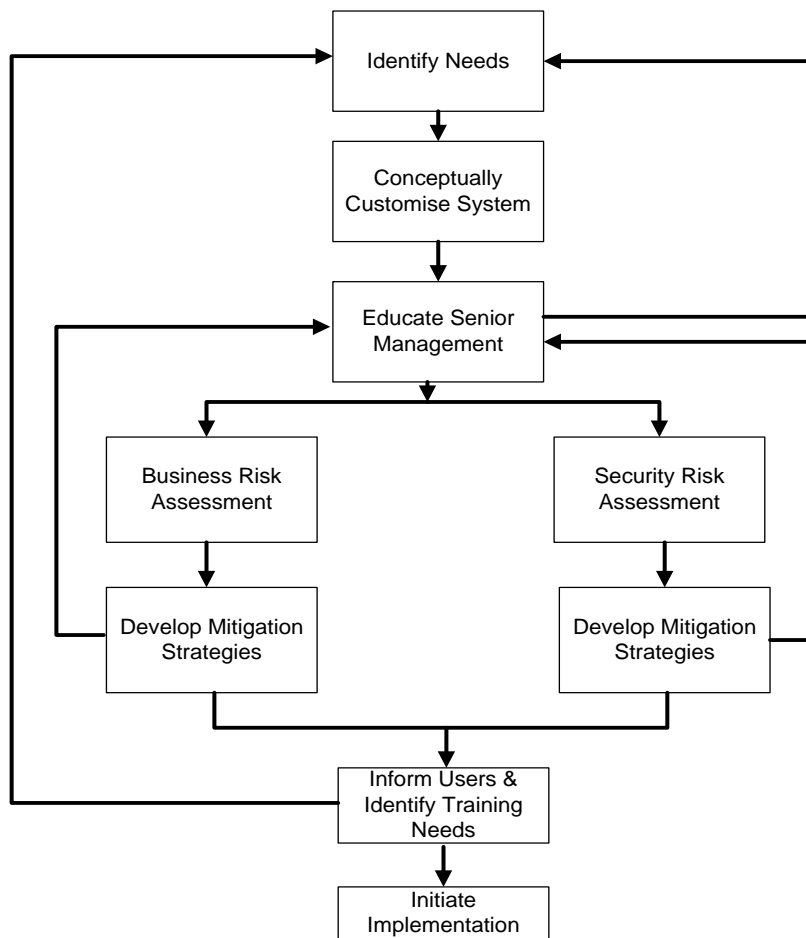


Figure 16. Proposed Implementation Model – B2B Enterprise Integration

During the re-visit to the participating companies this model was tabled for their feedback and it was adjusted to take into account their comments. These re-visits confirmed the main drivers to adopting B2B systems as external pressure from customers throughout the supply chain, acquisition of B2B systems by competitors and internal company demands from aspirational employees skilled in the use of B2B systems. Phase two case study was used to test this model and make adjustments to validate, or otherwise this proposed iterative model for UK ETO companies who are considering embarking on B2B enterprise integration.

## 5.8 Summary

This chapter presented a discussion on the findings of the key informant interviews at the eleven participating companies in the context of the interview questions raised in Chapter 4 and subsequently refined after the pilot as discussed in Chapter 4. These questions identified the managerial problems to the adoption of B2B enterprise integration in the participating ETO

companies. For the participating companies, knowledge and awareness at board level was found to be a key managerial problem to overcome. The other key managerial problems to overcome are concerned with business risk in the context of strategy (competition avoidance), payback on investment, business continuity, security risks and lack of key employee skills.

On reflection, previous research reported managerial problems to be limited to executive knowledge and awareness, lack of appropriate skills and security concerns. This research has confirmed these managerial problems and expanded them, covering business risk in the context of competition avoidance and payback on investment/affordability. These findings were used to propose a B2B de-coupled integration hierarchy and implementation model. The next chapter seeks to validate the B2B de-coupled hierarchy and validate the model during a case study at one of the companies, comprising a one full year budget cycle during a B2B implementation programme.

## CHAPTER 6 – PHASE 2 RESEARCH: COMPANY CASE STUDY

Phase 1 research analysis and discussion in the previous chapter summarised the key managerial problems associated with adoption of B2B enterprise integration amongst the participating companies to be:

- *Lack of executive knowledge and awareness of the application of the potential benefits from adoption of B2B enterprise integration in the ETO sector.*
- *Business risk in the context of strategy (competition avoidance), payback on investment (affordability), and business continuity through and after the implementation.*
- *Security risk due to the potential for loss of key intellectual property.*
- *Lack of key employee skills for the successful implementation and on going operations of B2B enterprise integration.*

In order to overcome these Managerial problems a B2B de-coupled hierarchy and implementation model was developed using the data from the key informant interviews. The aim of this case study was to validate the B2B de-coupled hierarchy and model by participatory action research at one of the companies from phase 1 who were preparing to embark upon implementation of B2B enterprise integration. This would enable B2B enterprise integration to be studied thoroughly by following the principles of participatory action research proposed by Denzil and Lincoln (2000):

*“Participatory research frequently emerges in situations where people want to make changes thoughtfully – that is, after critical reflection. It emerges when people want to think realistically about where they are now, how things came to be that way and from these starting points, how, in practise, things might be changed”.*

The case study company had identified the need for change and the perceived benefits from adoption of B2B enterprise integration. However, they were concerned about implementation issues and affordability. The approach adopted was to present the B2B de-coupled hierarchy and implementation model from phase 1 research to invite comments, suggestions and adjustments to overcome concerns. This followed the Denzin and Lincoln (2000) process of a spiral of self-reflective cycles:

*“planning a change, acting and observing the process and consequences of the change, reflecting on these processes, and then re-planning, acting and observing, and so on.....”*

This chapter presents the background to the case study company, the method of implementation followed as it unfolded and a comparison of its operating performance at the start and completion of the implementation.

## 6.1 Company – Background

The company offers bespoke engineered solutions to protect people and equipment from explosions, fire and noise mitigation predominantly for the offshore and onshore petrochemical markets. An examination of the company accounts and discussions with the directors indicated a stagnant operating performance at around £7m to £8m sales turnover and negligible profit levels over the period 2000 to 2007. Discussions with the directors, managers and reference to minutes of meetings confirmed there was no integration between functional departments' IT systems. The company did, however, have a website which was updated on a monthly basis.

A detailed examination of operating performance by reviewing contract statements revealed significant project cost overruns which were perceived by the senior management team to be due to inefficiency in manufacturing. As a result of these cost overruns, the directors entered into an agreement with a local institution during 2006 to carry out a study into the companies' manufacturing operating systems and to make recommendations regarding the implementation of an appropriate B2B integration system. The company had included a nominal amount in its annual budget to cover the cost of this study. This demonstrated the directors' awareness of the business benefits from adoption of B2B enterprise integration which can be compared to the technology acceptance models (Davis et al., 1989) covering perceived usefulness and perceived ease of use. Therefore, it is useful to make reference to the findings of the study from the local institution report and comment on why they were not resolved and why the recommendations were not adopted:

- Difficulties in planning and project management execution.
- Cultural issues embedded in certain departments and sites.
- Outdated systems currently deployed in the organisation, resulting in inefficiencies.
- Data extraction, manipulation and interpretation of data across the whole organisation.
- Difficulties in interdivisional and cross-site system linkages.

- Poor levels of control and visibility across the business as a whole.
- Lack of performance measurement indicators.
- Excessive use of paperwork and duplication across the organisation.
- Ineffective communication, i.e. top down, bottom up or lateral.

It should be noted that the report was incomplete because a number of departments did not prepare the process flow charts due to resource limitations and lack of buy-in from employees, e.g. embedded cultural beliefs and norms acting as inhibitors to organisation learning and improvements, as suggested by Reason (1998) and Smith et al. (2000). This was observed by the researcher referring to minutes of meetings. The report recommended seamless integration of the company's systems. The cost of such integration to an SME with 130 employees could typically exceed £1m. Following discussions with the local institution, there were two critical questions which could not be answered:

- What are the risks to business performance and continuity during implementation?
- How can the company's IPR and security be protected?

As a direct result of these unanswered questions the board of directors considered the risks vs. investment costs to be unacceptable. This compares directly with the findings in the previous chapter with regard to concerns on affordability and business risk/continuity of operations during the implementation. They agreed to put the project on hold, divert the funds set aside and proceed on a step-by-step approach which would involve the integration of specific functional departments, ensuring minimal disruption to ongoing business performance and at the same time protecting the company's IPR. In addition to the above, the company was extremely successful in securing new orders which would potentially increase turnover from £8m to £17m within a budget cycle. Therefore, it was essential for the company to embark on a re-structure programme to use its resources effectively and to use the step-by-step approach to the integration of B2B enterprise integration because:

- (1) The company could not effectively process a turnover of £17m.
- (2) The existing functional organisation used restrictive practices.
- (3) The volume of future work could not be processed with existing IT systems.
- (4) The factory space utilisation, plant layout and production planning was ineffective.
- (5) There were no IT links between the production operation and pre-production activities which resided in separate locations.
- (6) Employee culture was a "we always do it this way" attitude.

Following an analysis of the business product and market mix, the directors agreed that it was necessary to re-structure the company into product-based business units with a central manufacturing facility, each responsible for its own profit and loss account. The intention of the business units was to provide focus, based on Hamel's (2000) core competency model which suggests businesses within businesses, each with a specific range of products and a centralised master scheduling system.

This re-structuring programme was carried out and observed by the researcher over the period of the research and was used as the catalyst for introducing the step-by-step implementation strategy for integration of IT systems, as described in the following section.

## 6.2 Implementation Strategy Adopted

The findings from phase 1 research on the eleven companies identified in Chapter 5 concluded that ETO companies require a unique approach to implementation which is specific to their products and services. This was discussed with the directors and it was agreed to appoint a champion to the board with the authority to drive through implementation of B2B enterprise integration specific to the company's requirements. The directors were shown the B2B de-coupled hierarchy and implementation model developed from the phase 1 research for consideration. Following an explanation and review they considered it essential to adopt the B2B de-coupled approach to protect IPR and to retain control of the master scheduling within the boundaries of the company. They also reflected on the implementation model and suggested the addition of two iterative loops as a means of overcoming their concerns on affordability and business continuity.

In view of the poor financial performance of the company, affordability was seen as a major concern. Other concerns centred on the issues identified in the findings from phase 1 research, such as protection of competitive advantage (Cox, 1999), security (Daniel, 2001) and skills of the workforce (Stonehouse and Pemberton, 1999). Issues surrounding overcoming managerial problems due to the lack of executive awareness of technology acceptance models (TAM) (Davis et al., 1989) were not considered to be an issue at this company because they had already demonstrated their awareness of the benefits (perceived usefulness and perceived ease of use) by embarking on the study with the local institution.

Reference to directors' and management meetings highlighted positive indications that executives were aware, knowledgeable and accepted the benefits to the business of adopting B2B integrated systems.

The issues preventing progress surrounded affordability, future vision for the company, intensity of employee skills and the procedure for implementation to ensure business continuity. The directors had made the first step of appointing a champion with the authority to carry out a business analysis which set the strategy for enabling an increase in turnover from £7m to £17m in an 18-month period. As described earlier, the company re-structured into business units over a six-month period. During this period, action teams were set up to prepare proposals and implementation for the following:

- Update of website to raise profile of company into product focussed business units.
- Identification of bespoke design programmes.
- Status of 3D CAD modelling and the potential to integrate with materials control, nesting and profiling machines.
- IT time and attendance links to manufacturing work and finance.
- IT integration of finance, project management and procurement.
- Flow of materials and information to manufacturing – master scheduling.
- '5s' implementation to factory and offices.
- Employee IT training.
- Introduction of key performance indicators.

Each of the above were debated at board level and put into action teams. Their progress on implementation by one-to-one discussions, presence in senior management and directors' meetings and review of action team minutes was observed over the implementation period and is reported in the following two sections.

#### 6.2.1 Website Update

The company's mission statement was integrated with the business unit's products and matrix mix to reflect the following statement:

***“To be a world class supplier of solutions that protects people and equipment from explosion, fire and noise hazards. This will be achieved by providing a complete bespoke design, project management and supply service through its focussed business units comprising:***

- ***acoustic products***
- ***fire and blast wall products***
- ***modular and safeguard products each business having its own resource and manufacturing capacity.”***

In addition to the above, website configuration was adjusted to improve responsiveness and guide the engineer through a drop-down menu, providing instant access to company development, product downloads, certification, a news page, project updates, audited accounts and business unit contact details, including key employee photographs.

It was agreed for this action team to meet on a monthly basis to review changes and update the website accordingly. This team introduced a company newsletter called *Team Talk* which was issued to each employee on a quarterly cycle. This created a positive human relations environment where employees and the company engaged in information sharing.

#### 6.2.2. Process Integration

This team identified the requirement to provide connectivity between bespoke design programmes, 3D CAD modelling, material nesting and machine processing, as proposed by Soliman et al. (2001). It was recognised that this connectivity could be extended to enquiries, sales orders and manufacturing processing. However, as reported in the team minutes of meetings, serious concerns were expressed regarding further extensions of this connectivity to other areas of the business due to external links with auditors, customers and suppliers which could result in the loss of IPR. This concern centred on issues such as loss of sensitive company process information and loss of competitive advantage (Daniel, 2001).

Discussion with team members revealed concerns regarding the affordability of total seamless process connectivity, the time to implement such a system and the employee skill levels residing in the company at that time. The team concluded it would adopt the B2B de-coupled integration hierarchy approach which would provide connectivity between bespoke design programmes, 3D CAD modelling and machine processing, with links to enquiries, sales orders and manufacture processing. It would be de-coupled from finance, procurement, stock control and quality (refer to Figure 17). In addition, after reflection, detailed planning and testing the team adopted the implementation model from phase 1 with additional iterative loops to overcome the directors' concerns on affordability and business continuity.



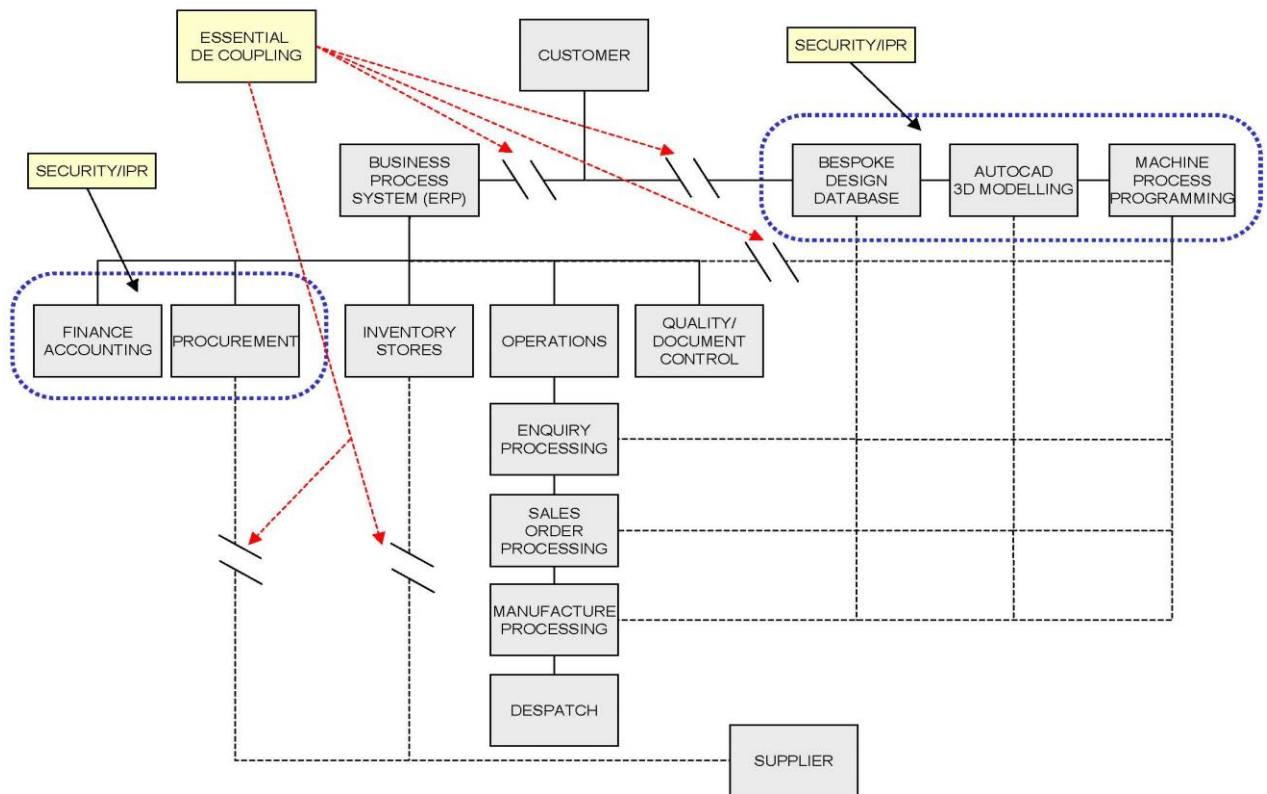


Figure 17. Mech-Tool De-coupled B2B Integration Hierarchy

The adoption of this proposal offered significant improvements to the flow of information, reductions in duplication and rapid response to change orders. Although not a fully seamless integrated system, as suggested in the supply chain theories such as Christopher (2000), Childerhouse (2006) and Harrison and Van Hoek (2008), it offered the comfort of protection of the company's IPR and hence retained its competitive advantage. This satisfied the needs of the company from concerns over security and loss of IPR highlighted by Attaran (2000), Lankford (2000) and Morris et al. (2000).

Another factor in this decision-making process concerned affordability and implementation. It was considered that the action team had the in-house capability to provide IT connectivity, thus providing considerable cost savings. However, from the meetings, it was apparent that the team recognised the need to acquire the services of a 3D CAD modelling expert to implement this process across the business units and the connectivity links with manufacturing processes. Subsequently, the company acquired the full-time services of a 3D CAD expert from a 'blue chip' business to provide the technical expertise and deliver the required connectivity. In effect the company was acquiring key employee skills to overcome particular

operational gaps, thereby improving skill intensity, as suggested by Bingi et al. (1999) and Rahim and Pennings (1987).

Similarly, the team identified in-house capabilities to provide connectivity between finance, project management and procurement. Conveniently, an upgrade on the company's accounts SAGE software was due and available at a nominal cost. The team took advantage of this upgrade, piloted the connectivity proposals on representative orders, trained all the relevant employees and rolled out the implementation within a three-month period. The new system enabled the increase in turnover to be accommodated within existing resource capability and capacity.

*“Timely and accurate information has become available to make informed decisions on business critical actions and we were able to maintain continuity during implementation.”*

This was quoted by the commercial director when interviewed after the implementation. This also took account of the concerns over business continuity during the implementation process because the company had introduced up-front training for employees and carried out pilot runs on the proposed system.

Introduction of an industry standard time and attendance system (at nominal cost), referred to as 'K time' was used to provide connectivity between accounts, payroll and manufacturing. The action team discovered this system was used by one of the UK's largest aerospace ETO companies as an added software package to their SAP operating system. It is worth noting that SAP has an integral time and attendance system but the aerospace company preferred to use the 'K time' software package because it provided greater flexibility for time and attendance compared to SAP.

*“The 'K time' software gives us what we need and is entirely flexible to meet our demands. SAP is okay but can be overcomplicated and cumbersome, at least from a time and attendance perspective.”*

The above statement was made by the aerospace company's IT representative during the case study company investigations into the selection of an appropriate cost effective time and attendance system. This, coupled with an affordable cost of less than £20,000 for the software, inclusive of implementation and one year technical support, was sufficient to convince the action team to acquire this product. Piloting, training and implementation took

less than one month. By the end of the second month manufacturing man hours per project, shift working premiums and indirect labour were integrated with the SAGE accounts payroll system. This information was made available to the operational business units on a daily basis, enabling informed decisions to be made with accurate real time information. This was considered to be a significant step forward from the previous system of clock cards, time sheets and date inputting, all of which was subject to human error and only available on a weekly basis.

*“The old clocking system just gathered information which was well out of date by the time it was available to us over a week later. It never seemed to tie in with the payroll and always gave us problems with the operators’ pay and project costing. We spent more time trying to sort out errors rather than improving manufacture performance. The new system takes all the errors out and we can now concentrate on what we are supposed to be doing.”*

The above comments were made by the manufacturing manager after three months operation of the ‘K time’ system. It was apparent that the company had used an interactive process to address concerns on business continuity, affordability and risk when deciding on the level of business process integration from B2B enterprise integration.

### 6.3 Employee Acceptance, Retention and Training

Although these factors are not technically part of the integration process, they are considered to be significant managerial problems that need to be overcome to ensure success. The work of Venkatesh and Davis (2000) and Riemenschneider et al. (2003) on technology acceptance (TAM2) and ease of use has particular relevance here. It was found that the company had a mature workforce (68% over the age of 50) and attempts had been made to recruit younger engineers who were knowledgeable about B2B integration systems. Unfortunately, it was observed by a discussion with the human resource representative that these younger employees would only stay with the company for one or two years and then leave. There was no record of leaving interviews but the human resource representative stated:

*“They just use us as a springboard to get some experience and then leave for more money. It’s difficult to keep them happy.”*

This compares with the attitudes expressed by Hollingshead et al. (1999) and the need to adopt human relation strategies which fulfil the needs of this generation (refer to Chapter 3.5

on human behaviour). The requirement for an ETO company's continuity of operation and ongoing improvement to keep pace with the rate of change in technology is considered directly related to its human relation strategy. This is confirmed by the work of Hamel (2001), Morgan (1997), Stonehouse and Pemberton (1999) and Handy (1995) where they cover aspects of employee empowerment, risk and reward as essential ingredients to organisational learning. Acceptance of this technology and the importance of ease of use, as explained by Reimenschneider et al. (2003), is an essential consideration in formulating human relation strategy, to not only overcome the managerial problems to adoption, but also to retain key employees. The directors of the company put together a number of initiatives as follows:

- Training programmes were put in place for all employees to improve their overall IT skill level in advanced Microsoft Word, Excel, Access, PowerPoint and Internet use.
- Key employees and new recruits were offered improved terms and conditions of employment which included extended notice periods.
- A monthly draw was introduced with 10 cash prizes.
- A social committee was formed and two free functions arranged per year, including a number of significant prizes and top class entertainment.
- Business unit employees were sent on off-site team building courses with specific emphasis on the acceptance of change management and streamlining operations with the use of new technology.
- Further education opportunities were provided for postgraduates to embark upon MSc and MBA courses. In addition, engineers were encouraged to become members of professional institutes and the company covered the annual fees. During the case study, two engineers became fellow members of the IMechE.

The above initiatives certainly helped to recruit and retain employees. From discussions with the senior management team and reviewing HR records over the period of the case study the company's employees increased from 120 to 180. Furthermore, none of the new recruits or existing employees left over this period. Existing employees and new recruits welcomed the changes and more importantly participated proactively in the introduction of the step-by-step integration of business process technology improvements.

*"We all think the changes have been great and it seems the company has a new direction. Our jobs have been made easier by some of the new IT software and we can all access the same information."*

The above statement was made by an employee with over 20 years' experience in the company. This can be considered as a short-term measure of how the directors' human relations initiatives have contributed to employees' acceptance of the IT technology changes and the positive impact this has had on the organisational social dynamics.

#### 6.4 Summary of Benefits and Success Factors

The company achieved its growth objective over the period of the study which is attributed, in part, to the success in securing new orders, but more importantly to the iterative approach to implementation of a B2B de-coupled integration hierarchy. As quoted by the owner of the company:

*"We could never have achieved the level of growth and improved business performance without implementing a de-coupled B2B enterprise integration philosophy into the company".*

In order to assess the impact to the company's financial performance as a result of this iterative approach to implementation of a B2B de-coupled integration hierarchy, the three macro measures from the previous chapter were reviewed with the finance director, i.e.

- The sales volume per employee should increase year on year.
- The work in progress as a percentage of turnover should decrease year on year.
- The working capital as a percentage of turnover should decrease year on year.

The factors which could distort the assessment, such as the effect of acquisitions/divestments, write offs, product development costs and capital expenditure, were discussed with the finance director. He advised that none of the above were significant over the period considered. Therefore, the above measures can be considered as reasonable indicators of the improvement in financial performance due to the implementation of the B2B de-coupled integration hierarchy. The following information was made available by the finance director.

<b>Year to 31<sup>st</sup> March</b>	<b>Turnover per Employee (£000s)</b>	<b>WIP as % of Turnover</b>	<b>Working Capital as % Turnover</b>
2009	81.10	15.95	7.17
2010	89.01	10.42	6.72
2011	109.61	7.63	5.41

From the above there is a clear indication in all three measures that there has been an improvement in the financial performance of the company. Based on the finance director's comments this can be attributed to implementation of a B2B de-coupled integration hierarchy using an iterative implementation affordable approach. As previously stated, these measures cannot be considered generalisable and should be taken on a case by case basis and only after reviewing the accounting data with finance directors.

The company also benefited from "in sourcing" (Friedman, 2006). Friedman uses the case study of the US company UPS who just a few years ago were essentially a packaging and distribution company. UPS is now a major global player retaining its core competency of packaging/distribution. However, its growth success has been attributed to in sourcing. As an example, Toshiba were having serious problems meeting global customer demands for warranty repairs to its computers. UPS handled the packaging and distribution of returned goods under warranty through its global network of operating hubs using B2B enterprise integration. Instead of returning the goods under warranty they agreed with Toshiba to repair the computers at UPS distribution hubs. This involved the training of UPS employees, providing value added and significantly reducing turnaround time and costs of transport.

Similarly, the case study company was involved in supplying specialised goods for an engineering prime contractor (EPC) to Asia. The EPC company's deliverables included generator skid units. These skid units had to be commissioned and tested using the case study company's specialised goods. Instead of sending both companies' deliverables to Asia for assembly, commissioning and testing with a potential loss of IPR, it was agreed to use the case study company's B2B de-coupled integration hierarchy and in source these activities. This provided the case study company with value added and demonstrated their capability to undertake additional work, preserving both parties' IPR and mitigating potential business risk.

The case study company was successful in appointing a champion who adopted an iterative approach to the implementation of an affordable B2B de-coupled integration hierarchy. It used

an iterative approach to mitigate the risks to business continuity, de-coupling to ensure security was maintained and improved the skill intensity of its employees by introducing a series of training and human relation initiatives. In addition, it gained benefits from expanding its geographical presence, real time data from production, seamless connectivity between the 3D CAD/CAM system and profile production equipment and improved project management/accounting data. These benefits enabled the management team to make informed decisions.

Based on this longitudinal case study and the findings in the previous chapter a set of recommendations will be made for ETO companies to consider with regards to the adoption of B2B enterprise integration which should assist them in overcoming the managerial problems that have been identified in this exploratory study.

## **CHAPTER 7 – RECOMMENDATIONS: IMPLEMENTATION OF B2B ENTERPRISE INTEGRATION**

The research has provided an in depth understanding of the four key managerial problems to overcome (*executive knowledge and awareness; business risk; security risk; required skill intensity*) for the adoption of B2B enterprise integration. In addition, it identified the importance of company size on the affordability or type of system to be adopted, as well as the guarantees required for business continuity throughout the implementation phase. This chapter recommends a model for the adoption of a B2B de-coupled integration hierarchy to overcome the key inhibitors that emerged from the research and addresses the issues of affordability and business continuity. With regards to the key inhibitors the following is proposed:

### **7.1 Executive Knowledge and Awareness**

The research found this to be an issue at board level and confirmed previous research by Froome (2000) and the CBI (2005), where it was claimed executives lacked knowledge of B2B enterprise integration and its business benefits. To overcome this there should be an increased level of board involvement in B2B integration initiatives, similar to US companies who appoint a Chief Information Officer (CIO). Part of the CIO's role should be keeping the executive board up to date with the latest developments in B2B enterprise integration including the performance benefits. In addition, the CIO (or equivalent) should co-ordinate the implementation of B2B enterprise integration initiatives ensuring each business unit or cell has a system which is configured to match the demands of its market. Attempting to implement a standard B2B integration package across a range of business units or cells could have disastrous consequences and lead to corporate failure when considering the business continuity issues described by Reason (1998) and Smith (2000).

### **7.2 Business Risk**

The participating companies considered that it is essential, in the adoption of new technologies, to appoint a champion or someone with the drive, enthusiasm and commitment to follow the project through. The outcome of the study revealed that companies decided upon the strategy and control on a committee basis. However, because there was found to be a lack of executive knowledge and awareness, the companies were slow to adopt B2B integration initiatives. This apparent slow level of adoption has to be considered in two parts:



(i) Those issues relating to a lack of executive knowledge affordability and fear of the unknown. These issues can be overcome by appointing a champion or CIO who is an executive board member and with the authority associated with such a position for B2B integration.

(ii) Those issues relating to a deliberate strategy to prevent loss of IPR and competitive advantage. These issues are company specific and understandable given the special dynamics of the ETO industry sector. The strategy and control for implementing B2B enterprise integration to mitigate risk, as proposed by Nunny (2000), can be considered but this does not cover business continuity. Therefore, a new model is proposed (refer to Figure 19). Companies considering implementing B2B enterprise integration should perform a comprehensive business analysis to determine the configurability it requires to match its market demand. This should take cognisance of the critical success factors identified in Chapter 3.

In adoption of new technologies, it is important to reflect on the sociological variables such as power within the organisation. For example, aspirational IT managers could be seen as a threat to senior management who may not have the required B2B system knowledge and skills. This could alter the dynamics and current distribution of power within the organisation. As found by Venkatesh and Davis (2000) in their proposed TAM2 research. Whilst this did not surface as an issue in this research, it should not be overlooked and could be an area for future research.

With regards to the business risk from a return on investment perspective, none of the participating companies had an established set of metrics for determining the business improvement as a result of adopting B2B enterprise integration. This creates a situation where the arguments for continuing the development of B2B enterprise integration are weak. Therefore, it is important to establish a set of metrics which can be used as the basis for measuring improved performance. However, companies should be aware that investment in B2B enterprise integration alone, such as SAP, Oracle, Epicor etc., does not guarantee improved performance. There are other organisational characteristics which must be implemented to form a coherent system of complimentary practices within a company, as suggested by Brynjofsson (2003). Based on the outcome of this study, there are three macro level performance measures which are recommended for ETO companies to assess the financial benefit to the company from the adoption of B2B enterprise integration

(i) Sales per employee.

(ii) Working progress as a percentage of turnover.

(iii) Working capital as a percentage of turnover.

These should be measured on an annual basis and adjusted to take account of acquisitions/divestments and other potential variances such as development costs and one off large capital investments etc.

This is only considered to be a starting point for ETO companies and is limited to the findings in this study. Future research should focus on the development and effectiveness of performance measurement methodologies at a micro level.

### 7.3 Security Issues

The industry sector analysis and study findings confirmed that ETO companies are characterised by high IPR ownership. This is because this industry sector focuses on the commercialisation of specialised knowledge which is customised to the needs of individual customers. Significant resistance to becoming embedded into supply chains which commoditise products was prevalent amongst all the companies. Furthermore, all companies viewed e-auctions with suspicion. At this stage in the development of B2B enterprise integration, it is recommended that ETO companies adopt avoidance strategies (de-coupling) when there is a danger of being locked into a supply chain. Similarly, when faced with e-auctions, ETO companies require an approach which makes visible its added value without losing competitive advantage. As B2B enterprise integration tools become more sophisticated, e-auctions for customised products should become increasingly viable. Therefore, it is important that ETO companies prepare for this eventuality and start adopting their mindsets accordingly.



Other concerns over access to HQ via the Internet, virus attacks and general security can be addressed with the use of access control, passwords and firewalls. Companies must ensure they have the ability to wipe data from a device should it be stolen or lost. All the participating companies were found to be compliant in this regard.

#### 7.4 Employee Factors and Skill Requirements

Based on the research findings, B2B enterprise integration changes the way in which employees work. According to Brynjolfsson (2003), it changes the role of a worker from a functional specialist to a process generalist, which requires data analysis skills and general problem solving abilities. Therefore, rather than B2B integration replacing human intelligence, it complements cognitive tasks and actually increases the demand for human information processing. It was found that the participating companies had re-trained their employees retaining essential core skills. In addition, it was found that companies employed greater numbers of skilled, educated and highly trained workers. Therefore, it is recommended that companies adopt a process of human behaviour actions to maintain their competitive performance during the adoption of B2B integration. These recommendations are:

- Automate numerous routine tasks.
- Recruit highly skilled IT employees.
- Decentralise decision making regarding B2B configurability.
- Introduce performance-based employee incentives.
- Continue with pro-active training.
- Harness those employees with creative skills to promote B2B enterprise integration.

It should be recognised that the implementation and operation of any IT system is only as good as the skills of the employees involved in the process. Realising the perceived ease of use and perceived benefits as outlined in TAM2 proposed by Venkatesh and Davis (2000) is fundamental to the success in adoption of this technology.

#### 7.5 Proposed Implementation Model

To overcome the managerial problems discussed above, the proposed model for implementation of a B2B de-coupled integration hierarchy derived from the phase 1 research has been adjusted and validated from the phase 2 research case study. This model is based on an iterative process that addresses the four key managerial problems and provides

feedback loops to executives covering affordability and business continuity. The model aims to inform the decision making process for the implementation pre-, during and post-implementation. From a validation perspective, the problems identified from the research and the model were presented to a senior director of the participating companies. They made several recommendations to improve the model, particularly in relation to the operation of the feedback loops. The model presented in Figure 19 includes all the recommendations. As discussed earlier, the ownership of processes such as the adoption of B2B enterprise integration increases the likelihood of success. Therefore, once a strategic decision is made to embark on B2B enterprise integration the first priority is to set up an implementation team led by a champion. This is the procedure followed by the executive board of the case study company. The next step is to verify the company systems by carrying out business process mapping to ensure nothing is missed, particularly legacy systems and how they have developed. At this stage it is important to test the market for appropriate B2B systems, check affordability and identify business continuity guarantees. For example, in two of the informant companies, implementation of the new system was either the responsibility of an engineering director or simply the IT manager, with no proactive approach for the development and implementation for the identification of needs. In another case (one with a more sophisticated system in place), the acquisition and implementation of the system was merely a response to changes in the market. The output of this process is then used to develop a new customised system. This customised system does not have to be an entirely new system but, as was demonstrated in the case study, an adaptation of existing systems using add on software. At this stage the senior management team needs to be involved in education and awareness because they will need to learn how the perceived benefits and perceived ease of use (Venkatesh and Davis 2000) TAM2; of the new customised system will be applied and what the challenges and improved performance will be. As a consequence of this stage it is very likely there will be recommendations for modifications which will be fed back to the beginning of this process as depicted by the flow of arrows in the model figure 19. These arrows and nodes depict the flow of information/mitigation strategies back to senior management who can then make informed decisions on the customisation of the B2B systems to meet their organisational requirements.

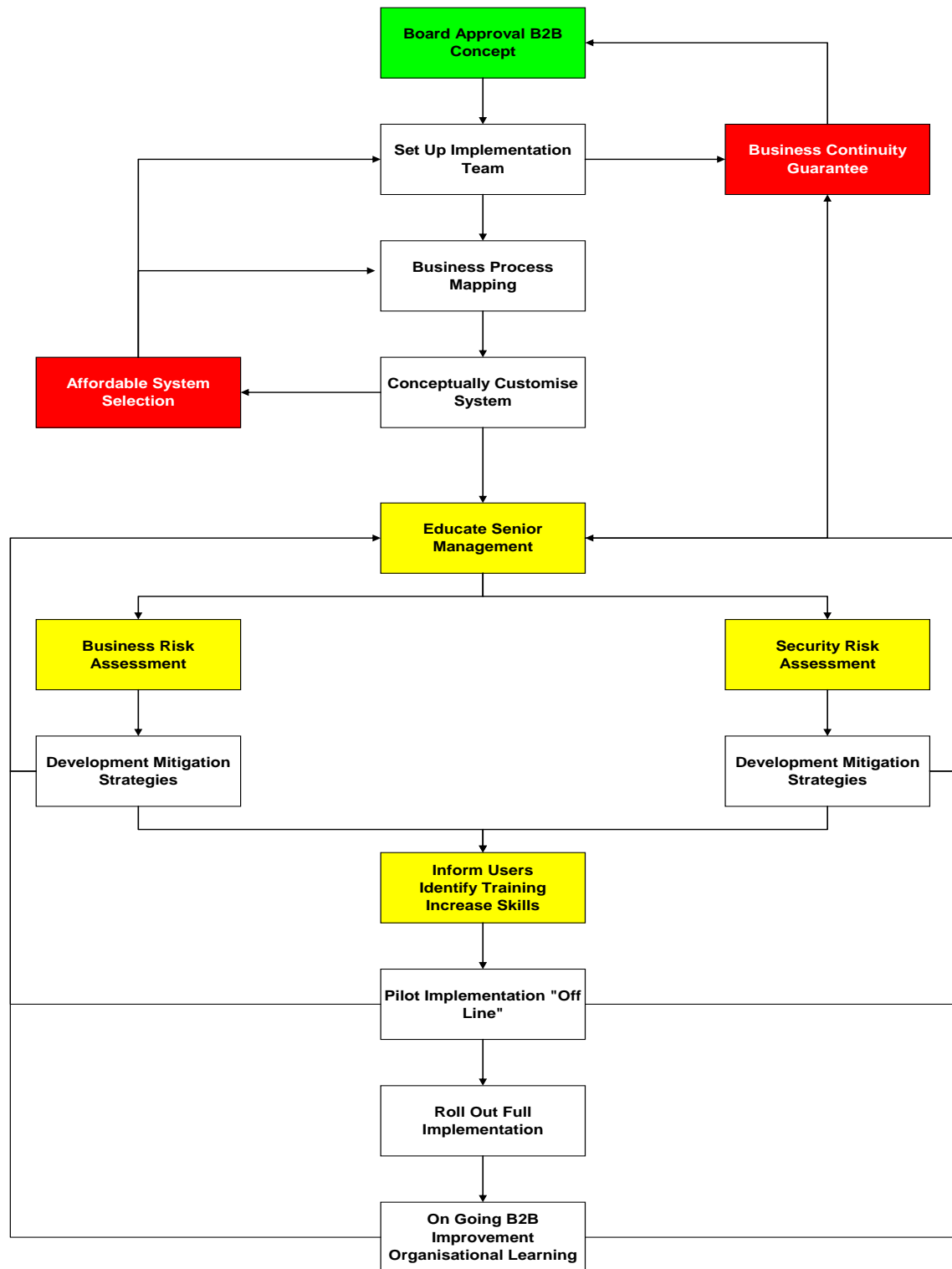


Figure 19. Proposed Iterative Model

These three initial stages will ensure that the new system is customised to the unique needs of each ETO and more importantly that there is management commitment which is considered an essential success factor in many projects, as highlighted by Holland et al. (2000), Hong and Kim (2002) and Harland et al. (2007).

The next step in the proposed model relates to the second and third problems identified covering business and security risks. Two parallel processes of risk assessment are proposed. The first explicitly examines the business risk and the second examines the security risk. It is believed that there will be overlaps between the two risk management processes. However, following discussions with the IT managers it was apparent that an assessment of the security risk involves technical detail which goes beyond the knowledge of those not IT specialists. Therefore, during the security risk assessment IT staff will identify potential risks and develop mitigation strategies to overcome them. The aim of the business risk management assessment is to identify how changes in the current processes will affect business performance and the need to guarantee business continuity. Again, this process should result in the development of mitigation strategies. The resulting mitigation strategies of both security and business risk will then be fed back to the “educate senior management” process and if needed the system will be modified to reduce the likelihood of the important risks occurring.

The final stages relate to the final problem identified: skill intensity. Previous studies have found that training influences user attitudes and behaviour towards new IT systems (Davis and Bostrom, 1993; Yi and Davis, 2001; Amoako-Gyampah and Salam, 2004) and return on investment (Rahim and Pennings, 1987; Mody and Dahlman, 1992). As a consequence, employees are more likely to be open to new technologies when there is a clear policy that encourages continued training and the company has established reward systems. As such, during the final stages of the proposed model the potential users of the new system are informed of the need for the new system. In addition, the implementation champion assesses any preliminary training needs. The outcome of this process will be fed back to the beginning of the model when there are significant gaps in the knowledge to operate the system or indeed a risk to the business continuity. The model also has a feedback loop post-implementation to facilitate ongoing organisational learning to cover the business continuity risks (Reason, 1998; Smith, 2000). As shown on the model and explained above, the process consists of several feedback loops which are primarily aimed at increasing the information available to the management, consequently ensuring their continued commitment. With this approach, B2B enterprise integration will be customised to the unique needs of an ETO and therefore it will strengthen the case for implementation and increase the likelihood of its success.

## CHAPTER 8 - CONCLUSION AND FUTURE RESEARCH IMPLICATIONS

This chapter summarises the key points of this exploratory study and in this way concludes the thesis. First, it briefly restates the research problem; second, it provides an overview of the study and its key findings; third, it summarises its contribution to theory; fourth, it discusses the contribution to practice; fifth, it discusses the limitations of the study; and sixth, it provides directions for future research.

### 8.1 Research Problem

Previous limited research identified manufacturers to be slow in adoption of new technologies such as B2B enterprise integration due to managerial problems. The purpose of this research was to empirically explore the managerial problems associated with adoption of B2B enterprise integration in the UK engineer to order (ETO) manufacturing sector, develop a B2B integration hierarchy to overcome them and propose a model for implementation. Chapter 2 of the thesis presents the reader with a historical explanation of the evolution of B2B enterprise integration, a definition and the business benefits of adopting such a concept. The research was grounded in the four main bodies of extant literature covering supply chain integration, information technology acceptance, crisis management in the context of organisational learning linked to advanced IT systems and ERP implementation success factors. A review of this literature was carried out in Chapter 3 including complimentary literature covering productivity and performance, security and human behaviour. Gaps in the literature were identified relating to ETO companies such as executive knowledge and awareness, realisation of business benefits and organisational issues which could explain the reluctance of executives and senior managers to fully adopt B2B enterprise integration. The literature reviewed and previous research does not provide appropriate models to overcome these problems. As such, there is insufficient knowledge available to ETO practitioners and a lack of implementation models to assist decision makers in overcoming these problems. As a result of this the study was focussed around answering the primary research question.

***“What are the managerial problems concerning implementation of B2B enterprise integration practices in UK ETO manufacturing companies and how can these be overcome?”***



## 8.2 Overview of the Study

Previous research, such as CBI (2005), into B2B enterprise integration was based on questionnaires on unrepresentative samples of the population of manufacturing companies. These identified executive knowledge and awareness, implementation strategy and concerns over security as the three main problems to be overcome in the adoption of this practice. To build upon this research, it was decided to adopt a two-phase qualitative research methodology to explore the managerial problems with adoption of B2B enterprise integration within ETO senior management's organisational settings. Phase 1 research was based on three informant interviews at eleven companies using a set of open-ended questions identified in Chapter 4 and subsequently refined by a pilot study. The companies were selected from an overview of the industry sector and their willingness to participate. Semi-structured interviews were carried out with a corporate director, operations manager and IT manager at each company. This group triangulation approach ensured issues surrounding reliability and bias were addressed. Informant interviews were transcribed into Atlas ti and a cross-case analysis used to identify the common problems with adoption of B2B enterprise integration. The managerial problems identified by this cross-case analysis using the key informants' quotations were used to propose a B2B de-coupled integration hierarchy to overcome them and a model for implementation. Phase 2 research was used to validate the B2B de-coupled hierarchy and implementation model. This focussed on a case study by participatory action research at one ETO company over a full year budget cycle to monitor the implementation of B2B enterprise integration. The case study validated the use of a B2B de-coupled integration hierarchy and raised the issue of affordability and business continuity during implementation as essential feedback loops in the proposed model.

## 8.3 Contribution to Theory

This research adds to the body of SCI and technology acceptance (TAM2) literature by identifying four major problems associated with adoption of B2B enterprise integration amongst ETO manufacturing companies. These are management awareness, business risk associated with loss of competitive advantage, security risk and the required skill intensity.

*Management awareness:* the level of awareness of the senior management teams was raised as a key issue in the implementation of B2B systems by the majority of informants. It related to the benefits and concerns on the implementation. It compliments the arguments found in the literature (Davis et al., 1989, Venkatesh and Davis 2000, Peppard and Ward, 2005, Childerhouse and Towill, 2006, Harland et al., 2007 and Flynn et al., 2010) regarding

perceived usefulness/perceived ease of use of these systems and the need for the benefits to be clearly articulated before embarking on adoption of B2B systems.

*Business risk associated with loss of competitive advantage:* The findings contribute to the body of literature covering crisis management (Turner, 1976, Reason, 1998, Smith, 2000) which relates to potential loss of business and system failure during implementation of new technologies. The reality trees (Figures 12 and 13) which were prepared from the phase 1 research interviews confirmed that ETO companies strive to continue operating in niche markets by customising or configuring their products. They oppose commoditising products and becoming involved in synchronous supply chains in contrast to the SCI literature. Their preference is to be de-coupled at the customer integration interface, thereby protecting competitive advantage, IPR and ensuring business continuity or mitigating system failure.

*Security risk:* It was found that ETO companies' IT systems store sensitive data which has been accumulated over many years of knowledge acquisition, testing and development. This provides ETO companies with their competitive advantage in niche markets. Seamless on line SCI can lead to a loss of sensitive data. As such, ETO companies are less willing to adopt a seamless SCI approach such as B2B integration. Given the sensitive nature and the amount of knowledge stored in the computer systems of ETO companies, high-perceived risk of a security breach is a major problem in the adoption of SCI systems such as B2B enterprise integration. The exponential increase in the level of cyber attacks has exacerbated this problem.

*Skill intensity:* ETO companies' technical knowledge was found to be relatively high. Their manufacturing and supply chain processes were found to be unique and with high levels of customisation. Therefore, employees accumulate a high degree of tacit knowledge which is difficult to replace. Thus, when requirements for new skills arise, such as adoption of B2B enterprise integration, training existing staff is a more feasible option than recruitment. The research emphasised the importance of "selling" the perceived ease of use and perceived benefits to users as proposed by the TAM2. Particularly the potential for job improvements, increase power within the organisation by social acceptance.

Whilst this research is specific to ETO companies the contribution to theory discussed above can be applied to other industry sectors where protection of IPR is a major factor in setting business strategy.

Another important finding which adds to the literature is that there is no accepted methodology for measuring improved performance following the adoption of a B2B system amongst the participating ETO companies. Previous research by Brynjolfsson et al. (2000) and CBI (2005) claim that adoption of B2B practices improves productivity and performance amongst manufacturing companies. However, this improvement cannot only be attributed to the adoption of a B2B system. Consideration has to be given to improvements in productivity as a result of the organisational transformation necessary during the implementation of a B2B system. Therefore, it is concluded that companies should benchmark and measure the improvements in productivity separately from implementing the B2B systems and the corresponding organisational transformation. Unless companies start to measure these two important elements of productivity improvement, the business argument for implementing a B2B system will continue to be a concern at Board level.

#### 8.4 Contribution to Practice

The research findings, the de-coupled B2B integration hierarchy and the proposed iterative model for implementation have implications for two types of practitioners: individuals within organisations that are trying to implement B2B enterprise integration and those that are developing them for ETO organisations. For the former, the important advice is that 'educating' the senior management about the awareness of system benefits and reducing the perception of any business risk would increase the likelihood of success. Indeed, during interviews with the informants and observations it was identified that in companies where the level of implementation was more advanced, the senior management informants were significantly more aware of the potential benefits. For the latter, the advice would be that the key to success of both the development and selling of B2B enterprise integration to ETO companies is to overcome the perception that these systems are risky by ensuring information security is not compromised.

The implementation model (Figure 19) proposed in this research and validated during the phase 2 case study is a recommended process to overcome the managerial problems identified in this exploratory study. If this model is used with the de-coupled B2B integration hierarchy it should provide the basis for successful implementation and should protect ETO companies from security breaches which could lead to the loss of IPR and the subsequent loss of competitive advantage. Furthermore, companies considering implementing B2B enterprise integration should perform a comprehensive business analysis to determine the configurability it requires to match its market demand. This should take cognisance of the critical success factors identified in Chapter 3. It is recommended that companies appoint a

CIO or equivalent to co-ordinate implementation to ensure each business unit or cell within the company has a system which is configured to its market. Attempting to implement a standard B2B system across a range of business units or cells within a company could have disastrous consequences and lead to corporate failure when considering business continuity issues similar to organisational failures described by Reason (1998) and Smith (2000).

## 8.5 Limitations and Directions for Future Research

The purpose of this exploratory study and the primary research question has been fulfilled. However, this exploratory research is based on qualitative data collection (in-depth open-ended interviews), cross-case analysis using informants' quotations and a full year budget cycle case study and thus is recognised as having limitations. Although such research provides an in-depth understanding of the phenomena under investigation in senior management organisational settings at different companies, it is difficult to provide generalisable conclusions. Therefore, future research could focus on the validation of the findings from this study and the proposed model by carrying out cross-sector studies using larger sample sizes. In addition, future studies could focus on the development and effectiveness of performance measurement methodologies to confirm the investment benefits of B2B systems. This would assist organisational strategists to make informed decisions before embarking on an appropriate B2B system. Finally, it should be observed that the speed in advancement of computer technology equipment and software limits the shelf life of this thesis.

## 8.6 Summary

Chapter 8 formally concludes the thesis. It restated the research problem, provided an overview of the study, its key contributions to theory and practice and lastly provided its limitations and direction for future research.

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